THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 15 JANUARY, 1936 Number 1

Photographs by Henry Holmes Smith

Commemorating the election of Ross C. Purdy, General Secretary of the American Ceramic Society since 1921, as Honorary Member of the Czechoslovak Ceramic Society (see page 29), the Ceramic School Branch at Modra produced the vase illustrated above and presented it to him. The painted decorations on the white background are in deep blue, yellow (in the animal figures and large flowers), and pale green. Outlines are in black. The piece is signed by H. Landsfeld. On the front is the inscription, which translated reads "To Mr. Ross C. Purdy who is elected an Honorary Member of the Czechoslovak Ceramic Society in Prague, June 2, 1935."

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Editorial and Advertising Offices: 2525 N. High St., Columbus, Ohio.
Publication Office: 20th & Northampton Sts., Easton, Pa.
Executive Office: 2525 N. High St., Columbus, Ohio.
Committee on Publications: L. Navias, *Chairman;* L. J. Trostel, M. F. Beecher, R. M. King, Ross C. Purdy

Entered as second-class matter at the post office at Easton, Pa., under the act of March 3, 1879. Published monthly.
Subscription $1.50 a year. Single numbers twenty-five cents
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THE BULLETIN

OF THE AMERICAN CERAMIC SOCIETY

A Monthly Publication Devoted to Proceedings of the Society and Promotion of Coöperative Research of Technical, Scientific, and Art Questions

Volume 15 **January, 1936** **Number 1**

PAPERS AND DISCUSSIONS

CERAMIC ART AND EDUCATION

EDITOR'S NOTE: The first Fall Meeting of the Art Division of the American Ceramic Society was held in Syracuse, N. Y., October 25 and 26, 1935, during the Fourth Annual Robineau Memorial Ceramic Exhibition. The papers and discussions presented here are from this program. The paper, "Art, Industry, and Education in Ceramics," presented by R. Guy Cowan is a thoughtful analysis of many of the problems confronting educators who are attempting to train designers for the ceramic industries.

Two other groups of the Syracuse discussions will follow in later numbers of *The Bulletin*, namely, "Ceramic Instruction in Secondary Schools" and "Small Kilns for School and Studio Service." These discussions contain so much of value to both amateur and professional potters working in schools, studios, and personally owned shops that it is contemplated enlarging the material for publication in book form.

INTRODUCTION

BY LAWRENCE E. BARRINGER*

This meeting for those interested in the development, production, and appraisal of ceramic ware by individual workers, both amateur and professional, was called largely as an experiment to ascertain whether or not there are enough matters of common interest or opportunities for mutual helpfulness to justify further efforts to provide a better means of contact and association than have heretofore prevailed.

Since its organization in 1898, the American Ceramic Society has been chiefly concerned with the principles and technique of organized industrial production rather than with the creative art of the individual.

There has long been this Art Division of the American Ceramic Society for the consideration of matters pertaining to the form, color, and decoration of ceramic products, but it has been difficult to maintain an interest in these phases apart from the actual manufacturing operations. It has been the opinion of some that there was need for an entirely different arrangement for those interested chiefly in ceramic art, both industrial and non-industrial.

If one takes the trouble to inquire, it will be found that in nearly every community there are individuals teaching, producing, collecting, or interested in pottery, tile, glassware, and other ceramic products. Studio potters will be found in all parts of our country, producing original and very creditable ware in rather unexpected localities, as on the island of Nantucket, twenty miles at sea, high in the green hills of Vermont, and on farms in the back country, remote from centers of trade and industry.

A rough estimate made a year or so ago placed the number of studio potters, school-group potteries, and similar enterprises at about 2000. Since then a partial survey conducted with the aid of members of the American Ceramic Society

* General Electric Company, Schenectady, N. Y.

has indicated a total very close to the original estimate.

Returns from invitations sent out for this conference brought replies from 141, 135 of whom expressed definite interest and only six indicated no interest.

The question then arises as to whether or not this group of ceramic enthusiasts and workers desires some medium of exchanging information, of meeting at intervals for discussion of products and problems, of viewing one another's wares, and of recording and distributing information of substantial and lasting value.

Is there a desire for an annual display of ceramic products from individual or craftsman potters, thus continuing the work so successfully initiated and so ably conducted by Miss Anna Olmstead in Syracuse?[1] Would an annual meeting be generally desired? Would there be justification for a new publication devoted exclusively to ceramic art and would there be support for such a publication? We hope these and other questions were answered, at least partially, by this conference.

The topics presented at this first meeting were but a few of the many subjects relating to ceramic art which might be profitably discussed at future meetings. In the realm of art and archeology, for instance, papers and discussions dealing with the development and significance of classic ceramic ware of the past would prove stimulating and instructive to the younger workers. Such a paper was that of Dr. Goldman[2] which appeared in *The Bulletin* last year.

Whatever the eventual program, however, we hope that the papers and discussions at this meeting will form the nucleus of fundamental information which will be made permanent for the guidance of many others.

If this Art Division meeting, by frank discussion, crystallizes opinion in the subjects selected for discussion it will have well justified itself.

[1] The Robineau Memorial Ceramic Exhibition, held annually at the Syracuse Museum of Fine Arts, Syracuse, N. Y.

[2] Hetty Goldman, "The Bronze Age Pottery of Greece," *Bull. Amer. Ceram. Soc.*, **13** [11] 301–308 (1934).

CERAMIC ART EDUCATION PROBLEMS IN THE COLLEGES

By M. E. Holmes**

This subject is complex. Colleges vary and so do the methods and objectives of ceramic art education. Liberal arts colleges may offer ceramic art training as an option in the senior year of a four-year course devoted primarily to a general liberal education. Art schools devoted primarily to general art and craftsmanship may offer ceramic art as one of the featured options. Finally, there are ceramic art schools specializing completely in ceramic art and offering no courses except those which function directly or indirectly in the training of ceramic artists.

In each of these three types of schools the objectives may vary. In some cases the intention is to train students as teachers of elementary design for high and secondary schools. In other cases the objective is a studio potter who may be not only a designer but engineer, salesman, and general manager as well. The training of ceramic designers for the larger ceramic manufacturing companies is a third objective that may prevail in the ceramic educational institutions.

The question arises as to whether, in all this variation among the colleges and their objectives, a common point of view can be established for this discussion. On the other hand, is it true that ceramic art education is so inflexible and standardized that it is essentially the same regardless of the kind of institution in which it is taught and the objective that may prevail? If not, perhaps we can most wisely discuss this subject from the point of view and with the emphasis on the training of industrial ceramic designers for the larger ceramic companies.

What should be the curriculum of a ceramic art course? Should drawing be included and made the basis of the entire course of instruction? If so, should it not be the first study pursued? Should it constitute about 37% of a four-year course? What should be the relative emphasis

** Dean, New York State College of Ceramics, Alfred, N. Y.

placed upon cast, still life, landscape and flower, and life drawing from models? To what extent should perspective be introduced?

What part of the entire course should be given to a study of the general principles of design in which emphasis is laid upon the development of originality and creative ability? Is this subject worthy of about 23% of the entire course and how can it be best correlated with the work in drawing?

Is ware production an essential part of the course? Should students produce pottery and other ware in connection with their study of its design? If so, what standard of excellence should be established? Is 15% of the entire course applied to ware production adequate?

Is modeling, as a means of bridging the gap between design in the flat and production of ware in the solid, an essential part of a ceramic art course? If so, is 7% of the course devoted to modeling adequate?

Should mechanical drafting be included and what degree of emphasis should be placed upon it?

To what extent should general cultural liberal arts courses be included? Is 20% of the course devoted to the subject about right? If no more than that amount of liberal arts training is included, it offers difficulties in granting the Bachelor of Arts or Science degrees. Engineering courses leading to these degrees include as much as 75% of nonspecialized work, largely general science and liberal arts. It has come to be quite generally agreed that the above-mentioned degrees should be limited to courses having much more than 20% of nonspecialized work. If the Bachelor of Science or Arts degree can not be granted, is the Bachelor of Fine Arts the most acceptable? Is ceramic art enough of a fine art to justify the degree? Would the degree of Bachelor of Ceramic Art be more suitable?

Are the courses mentioned above the essential ones in a ceramic art curriculum? Should any other subjects be included in order to give a graduate the essential training he needs to be of immediate usefulness as a ceramic designer? Is industrial experience necessary for the graduate of a four-year course of training, as outlined above, to render service of value as a ceramic artist? Of course, natural talent and ability will enter the picture, but the question should be considered from the point of view of graduates of average ability.

If ceramic ware production is to be taught, what ware should be included? Should it be limited to whiteware, using the term to indicate not only clayware but ware made from synthetic mixtures of clay, feldspar, and flint. Even if the instruction is limited to this type of ware, extensive work in bodies, glazes, and colors is required. In addition to the pottery and dinnerware of the whiteware field, we must consider the eligibility of glassware, terra cotta, and ornamental enamelware as ceramic art products. Should the scope of ceramic art training be broad enough to include all these types of ware? Quite different principles of design are involved as well as different methods of application.

After considering the essential studies in a ceramic art course, the practicability of offering them arises. Are four years sufficient time for adequate training? If not, how much should the course be extended? Is the operating of a pottery for students in connection with the art school necessary? If so, what standard of quality of ware should be established?

In the background of the practical details of specifying just what should be in a ceramic art curriculum are the requirements of the industry and the dictation of public taste. Can a ceramic art curriculum be developed on purely theoretical grounds or is it necessary to ascertain what the industry requires and public taste demands? What particular characteristics of the American ceramic art industry will have a determining influence on the course of the development of ceramic art education? The ceramic art industry of America, in contrast with that of Europe is, to a large extent, a mass-scale production of a limited number of designs. Should we develop ceramic art education to train our graduates for this industrial condition or should we accept the belief of some that the trend in America will, from now on, be away from this type of production toward the small, individual studio pottery status of the European industry? Quite different types of training are required for the two conditions. Certainly more freedom for creative work is offered by the European method, where the design of the artist need not necessarily fit into a rigid standardized manufacturing procedure. Is such an industrial status necessary for the development of ceramic art education to a high degree of effectiveness? On the other hand, does our American industrial system offer opportunities as

well as restrictions with rewards commensurate with the difficulties involved?

As a means of fostering ceramic art education should the manufacturing industries be encouraged to develop a small studio pottery program as a side issue with them?

What bearing does the American tendency toward standardization and simplification in industrial production have on the prospects for ceramic art?

Are the requirements of the industrial ceramic designer so specialized and exacting that a highly specialized training in ceramic art is required, or is it practicable for the general designer to meet the requirements? Can the designer of such industrial products as refrigerators and cameras be called upon by the ceramic industries to design a new line of dinnerware for them, or is it true that the technique of ceramic materials and processes is so different from all others that complete specialization in ceramic art is required?

Does the American ceramic art industry need the craftsman to copy and modify European design or does it need creative artists for the production of typically American ware? Can the head moldmaker be America's ceramic designer or is the time coming when our industries will require creative artists of extensive collegiate training?

The item of the influence of public taste enters the picture prominently. Is the public right and the artist wrong when any particular design does not sell? Should artists design ware that they think is right and then attempt to educate the public to its approval, or should they ascertain the criteria of public taste and fit the design to those standards? Is public taste a uniform, standardizable thing, the same for the Mexican Indians as for the nobility of Europe or does it vary geographically and socially? If so, how is that element of control to be brought into ceramic design and the training of ceramic artists? Should the items of merchandising and salesmanship enter into the training?

During recent years there has been a rapid development of public interest in design. Automobiles are now sold largely on their appearance. Industrial products must be beautiful as well as efficient. Can not that trend be expected to make itself felt more prominently than heretofore in the ceramic field and does it not augur favorably for the future of ceramic art and ceramic art education?

Finally there arise the questions regarding the raw materials of ceramic art education, the students. How are adaptable students to be selected and how are their special talents to be ascertained and developed? Should they be divided into groups, some trained as teachers and others as industrial artists? After graduation, how are prospective employers to judge their potentialities?

The questions given above have arisen from several sources, such as papers on the subject, notably Mr. Cowan's paper which follows, and from conferences with ceramic artists and educators on the problem of ceramic art education. They are submitted as suggestions for discussion with the belief that they constitute some of the more important questions now confronting those charged with the responsibility of developing ceramic art education. Like ceramic technology and engineering education, ceramic art education is not perfect. Great progress has been made in developing each of them and they are functioning effectively in various ways, but the best way to bring about logical development and improvement is to invite constructive discussions and suggestions.

ART, INDUSTRY, AND EDUCATION IN CERAMICS*

By R. Guy Cowan

Abstract

This paper is divided into four parts, as follows: (1) several fundamentals, which it is believed all of us should recognize and understand, whether we represent industry, the professional artists, or the schools; (2) the ceramic industry in America and Europe; (3) ceramic art education, our schools and their efforts to cope with the present situation, and a critical survey; and (4) constructive suggestions for the improvement of the situation. The points are outlined, maintaining an engineering viewpoint of cause and effect.

INTRODUCTION

The time is approaching when it will not be necessary to preach the value of the artist to the industrialist. Manufacturers, whose success has come about through making better-designed merchandise, are no longer so few as to be unique. The success and the example of these firms should speak louder than mere words. In the belief that it is now time to turn our attention to other aspects of the situation, this paper is devoted to an analysis of the main problems.

I. FUNDAMENTAL CONSIDERATIONS

An Industrial Age

Primarily, we are concerned with industry. Even if we do not like it, this is an industrial age. Either directly or indirectly, most of us are dependent on industry, large or small, for our living.

Even among those who accept our industrial age, possibly with resignation, there are criticisms that it is neglecting its duties to the public. Undoubtedly, this is true. Most of us do neglect our full duties. In the art and scholastic world there is a great deal of talk of the duty of "educating the public to better taste." There is an evident feeling on the part of some that catering to the public taste is an evil thing. Such an attitude is not entirely justified.

Just in the same manner that most of us compete within industry for the jobs that give us a living so also does one industry compete with another industry for its "living." When the individual is hired by industry to perform certain work, his first moral responsibility is to do that which he is paid to do, as honestly and faithfully as lies within his power. When the individual buys the product of industry, the act of paying for services obligates industry to do that for which it is paid, as honestly and faithfully as possible.

These last few years of depression should have taught us that the chief moral responsibility of industry is to furnish work and a steady living income to labor. If industry is to live it is forced to cater to public opinion. It must make what people will buy. It defeats its main purpose if secondary considerations interfere with its primary purpose of making sales.

"Good Taste" in Industrial Products

It is hardly to be questioned that a man, whether artist or not, has a perfect right to make that which he desires to make. But does that right extend to the point where he can expect other men to buy even if it is not what they want? No artist would question this principle if he were buying a motor car or a washing machine. Under those conditions, he would expect industry to supply what he demands. Whether motor car, picture, or piece of pottery, the same principle is involved. When you pay a man or an industry to make an article or do a service for you, you feel the right, because you pay the bill, to receive that which you want.

When industry caters to the lower passions, and more harm than good comes from such efforts, the situation is entirely different. This country has recently taken decisive action on one of the "arts" of the country. It decided in unmistakable fashion that it did not want filth in the movies. Here a moral responsibility or duty should have taken precedence over business success. Peculiarly, in this case, the movie magnates were just stupid in believing the public wanted filth.

Were it possible to reduce the question of "good taste" to some fairly definite standard

* Presented at 1935 Fall Meeting, Art Division, American Ceramic Society, Syracuse, N. Y., October 25 and 26, 1935. Received December 16, 1935.

and to prove that variations from that standard were destructive of the common good, as in the case of the movies, then we would have some basis for argument.

Suppose that we can convince the industrialist that it is his duty to educate the public. Which of the many sets of standards of good taste is he to adopt? Are we not treading on dangerous ground when we sacrifice the success of business to a purely personal reaction? After all, is there any proof that we are right and the other fellow wrong?

Style Changes

We are dealing with something vastly different from good taste when it comes to efforts to create style change. It is smart business to contribute through advertising to the obsolescence of what people now own. It is good business to create in people's minds a dissatisfaction with what they now have and a desire for something finer and better or, at least, different. It is a fine, altruistic thing if, in creating style change, education of the public to better things is accomplished, but there is no duty about it.

The problem of raising the level of public taste is most emphatically not one of making converts to an individual's point of view. The country and the world in general will find higher levels of appreciation if greater interest in art can be developed.

Artists and Craftsmen in Industry

There is another phase of the problem than the one just presented. If only the angle presented in the previous arguments governed human life, there would be no room for the great teachers, for the great geniuses who have changed the currents of human life. In the past centuries, artists have worked and labored to convince their fellow men that all was not right with the world. Out of thousands possessing unconventional ideas, a few dozen have changed the outlook of their generation or of generations which have followed. While it is the contention here that industry must of necessity remain impersonal or neutral to personal ideas of "good taste," the individual who believes he has a message for his fellow man should still have a place in the world.

The man in business, the layman from the artist's viewpoint, together with the mass of people, has a misconception of what constitutes an artist. To the average person any one who paints, draws, or models well is an artist. On the contrary, such a person is a craftsman. He is no more an artist than a skilled garage mechanic is an artist.

The artist is one who, together with being a craftsman, has the power to create. His talents are closely akin to the inventor. The craftsman and the artist have the same relation to each other as the skilled machinist has to the inventor of machine tools. The inventor of machine tools might be a rather indifferent machinist.

The business man should not confuse his two requirements. If he intends to copy the work of some competitor or the work of past ages, he requires a craftsman. If he wishes to create a new product in the spirit of the times, he requires an inventor, an artist.

In the pottery business, particularly until recently, it has been the habit to expect the decorator or the head moldmaker to be the artist. These men must of necessity be good craftsmen; they also must be good executives. Rarely did it happen that such a man was truly an artist.

Fortunately, this erroneous idea is being corrected. In the correction of it, American industry is very rapidly divorcing itself from copying of foreign products. American products will, in time, lead the world in style, design, and character. A country which has contributed so much to mechanical invention will do as well in creative art work.

Designers in the Pottery Industry

In the field of purely industrial design there is much to be desired as far as personnel is concerned. A few men, like Norman Bel Geddes, are engineers as well as artists. Men of his type have a sense of merchandising, of manufacturing, and utility of product. A number of such men have flitted from industry to industry and achieved amazing results. Due to their ability to acquire publicity and, in most cases, due to their real ability as designers, they have been very successful.

Most of this success has been achieved in industries which have never realized they had design problems to solve. In the pottery industry, it is questionable whether talent, no matter how great, can "flit in and then out" and leave a lasting impression. The same thing is true of glassware.

After all, in such trades there have been master artists through all the ages who have worked in those mediums. That is not true when it comes to vacuum cleaners or scales. What the ceramic industries need is talented men, such as Bel Geddes, who will go into specific industries, become intimate with the materials, and then out of their creative minds evolve new products and new ways of using old products, thus building new industries. Josiah Wedgwood was just such a man, artist, engineer, and business man. His achievements would have been impossible without a life spent in mastering the materials with which he worked.

II. THE CERAMIC INDUSTRY IN AMERICA AND EUROPE

In arriving at a proper solution of our problems, the conditions which are peculiar to American industry, together with their future trend, must be recognized. In contrast, we should study European industry for the purpose of accomplishing in our country the happy relationship between art, industry, and education which is enjoyed abroad. Whatever relationship we accomplish will of necessity be based on an American point of view on the part of industry, education, and the personnel involved.

Industry in America is based on large-scale units, each producing a small variety of items. Competition between individual units and foreign importations develops a constant strife between the desire and necessity to cut down the number of items and the equally desirable objective of developing new markets. Each unit of industry will always have this problem before it, to be solved according to the shrewdness of management. Gone forever are the days of staple lines of merchandise which can be marketed year after year.

Industry in England and Europe is based upon small units or groups of small units, producing a great number of items. In visiting the Staffordshire district of England, one is amazed at finding literally hundreds of potteries operating independently. Not only that, but in the same plant one will find everything being made, from Rockingham tea pots through earthenware to bone china.

On the continent, the same conditions are true. The writer visited the Leipzig Fair in 1930 and found over 800 potteries exhibiting their ware for sale. Most of these were from central Europe. While visiting the plant of Carl Thieme in Dresden, in company with several American buyers, the seemingly endless variety of products was remarked. The sales director said there were over 29,000 items on display in the showroom, any one of which would be made to order and none of which was made except on order.

The most noticeable characteristic of European ceramic products is found in the superior craftsmanship. The reasons for this are not difficult to find. The principal one is the low wage scale which makes possible a vast amount of hand labor. The highest wage the writer could discover in Germany (at Meissen) was twelve dollars a week, one-third to one-quarter of our own, paid for work requiring skill beyond our American workmen. Probably the contentment with spending half a lifetime in attaining this supreme skill belongs to an older civilization, a more settled one. It is but human nature to take pride in the work of one's own hands, but the ability to build industries out of the work of craftsmen belongs only to communities where the scale of wages is low.

The American manufacturer has had no choice but to speed up production, but in so doing he has lost the spirit of craftsmanship on the part of his workmen. It has been a case of speed up or die. The problem which faced America was to secure a good product by means of the machine. With the machine and modern straight-line production, however, a great variety of products was quite impossible.

Because European ceramic industries are split up into a multitude of small units, and because of the universal crafts spirit and the ability of industry to operate on the basis of making a few of this and a few of that, the opportunities for the young art student are multiplied a hundredfold. The contrast to American conditions is almost tragic in some of its effects.

The American manufacturer, being faced with the necessity of producing a few items, has been unable to experiment with goods which had but little chance of volume sales. He has had to stick to goods which met a popular demand wide enough to run into quantity. This has kept him working in the tried and true channels.

Opportunity for American Artists

One of the most important defects of this situa-

tion lies in the lack of opportunity given to a large number of artists to work in these industries. The number of industries has been small, and in each industry the art development work has been limited.

Whether industry would have used ceramic art talent of real ability, had it been available, is a debatable point. That little such talent was available is a fact. At least, there was little available which had been trained in ceramic processes. There has always been native talent which, if interested in ceramics, could have been trained to do fine creative work. Until these last few years it is also true that industry did not realize it needed real art talent and that it was quite satisfied with what it had. Presumably, if men interested and well trained in ceramic art had gone into industry, they would have awakened the ceramic industry to new possibilities.

All of us go along in our little ruts until we are jolted out of them. Industry during these last few years has taken its jolting, partly got out of its rut, and has found talent to make a grand start in creating new ware.

One of the most important changes which has taken place in America is purely psychological. We, as a nation, have for generations had an inferiority complex toward Europe. Some of the blatant Americanisms of which our people have been guilty while traveling in foreign lands have been a defense against this subconscious feeling of inferiority. Without being aware of it, the petty dealings of Europe with us since the war have diminished our worship of things foreign. As this feeling grows, America will have a quiet reserved feeling of equality at least, if not of superiority, which will not need defense. This change in attitude, as time goes on, will help tremendously both the artist and industry in marketing its product. No defense will be necessary for the label "Made in America."

III. CERAMIC ART EDUCATION

In dealing with the subject of ceramic art education, it will be difficult to avoid controversial grounds. The hope is that it may be possible to agree on some of the fundamentals, on some of the obvious faults in the present system.

Ceramic art educational efforts have three approximate outlets for those so trained, namely, (1) the industrial field, as represented by the large industries of earthenware, chinaware, tile, terra cotta, and low-priced artware, (2) the craft field, making highly individualistic ware on a small scale in studios or wayside potteries, and (3) teacher training, largely for the secondary schools and other work with children.

Since we have no exact yardstick to measure the accomplishments of our schools in these three directions, we must attempt to measure these accomplishments as compared to the efforts expended.

The accomplishments must be judged in two different ways. First, as to how successfully the graduates have been placed in their chosen fields of work, and how well they have succeeded in that work, and second as to whether their accomplishments have added to the cultural and material assets of our country. The first is a question of how much the students received for their four years' investment of time and money, while the second measures the value which the public received for its investment in establishing and maintaining the schools.

This appraisal requires also that a comparison be made to the accomplishments of others in these fields, men and women who did not have a course of study in these American ceramic schools.

Our ceramic schools are largely state institutions. In large part, the purpose of establishing them was to develop natural resources. It follows quite logically that an important function should be the development of personnel to assist our industries to do a better job in competition with the rest of the world.

This brings us to a consideration of the first field of work, the industrial. There have been perhaps a score of individuals who have made substantial contributions to American ceramic art. There are perhaps that many who today are doing creditable work for our industries. Among them, very few have come from our ceramic schools. It would be interesting to study the background of those who did not go to the ceramic schools to discover whether they suffered or gained from the lack of specialized education. Such a comparison might not be very complimentary to our ceramic schools.

In the second field, that of craft ceramics, the answer is somewhat better. Yet if again we make a list of those who have been doing the best work during the past twenty-five years, we shall find that the leaders, for the most part, have been

without the benefit of ceramic-school training. We must take into consideration that more individuals have arrived at a high degree of ability without the training than with it. Since this is written to reach a limited group which is quite familiar with ceramic accomplishments, further analysis is unnecessary.

In the third field, teacher training, the question arises as to whether our ceramic schools have used any unit for the measurement of success, other than the ability of their students to secure jobs. The view of the writer, having enjoyed the security of such a job during the depression of 1907 and 1908, is that this work is, in many cases, one of the educational fads which increases the burden on the taxpayer of today without compensating returns. There is not room here to discuss this point in detail, but it seems to be true that the pottery work turned out in the public schools is for the most part so crude and uninteresting as to fall far short of justifying the cost of production. Consideration has not been given to the fact that most of the merit (and often the only merit such pottery possesses) lies in glazes and colors applied by the teacher, who also prepares these materials and does the firing. The writer knows that there are exceptions to this general criticism.

Development of General Art Education

As a background for our study of education, it will be helpful to cover briefly the development period and the present tendencies of general art education. In the beginning and up to modern times, the apprentice system constituted the means by which artists were developed. All of the arts, including painting and sculpture, were crafts. From among the classes of cabinet-makers, stone-masons, silversmiths, and gold-smiths, the most talented were apprenticed to the painters and sculptors. Such men, although they became masters of their crafts, were continually working in the decorative arts and as engineers and architects.

Unfortunately, during recent times there grew up a sharp distinction between the "fine arts" of painting and sculpture and the lesser arts of "crafts." The "fine arts" became a part of a false culture or activity of the leisure class. When our rich men founded the first of our art schools and art museums, the display and the teaching of modern decorative arts were far beneath their notice. These schools taught painting, including portraiture, and they taught sculpture, but sculpture they believed, to have any value, must be carried out in marble or bronze. Among the sculptors there were but few who were good enough craftsmen to carve their own marble. They modeled in clay, the foundry cast the bronzes, and the stone-cutter carved their marble.

Gradually, influences were brought to bear upon these schools to teach the less talented students something of the crafts. The greatest influence of all, however, in bringing about this change, came through the development of modern advertising. After this opening wedge, progress was rapid.

Possibly of importance equal to the influence of advertising came the general movement all over the country to teach art in the public schools, from the kindergarten through high school. This development came about too fast to secure the best of results and our art schools and state universities became factories to turn out thousands of girls, with a few boys, to teach a subject for which they had but little talent. The only requirement to get an art teaching job was to be able to get passing grades in a wide variety of subjects with art as a side issue. Nine out of ten high-school students, provided they had the inclination, were capable of so preparing themselves to teach art.

Over a period of many years of interest in and association with art schools, the writer has come to the conclusion that the students in our art schools and art departments of the universities may be divided roughly into three groups. The first group, with the greatest native talent, takes up "fine art" to become painters and sculptors. The middle group goes into advertising or the decorative arts, and then those students who realize at the beginning, or shortly after, that their talents fall short of success as professional artists, become teachers of art. There are many exceptions to this, for among our teachers are hundreds who could make a success of almost anything they cared to attempt.

Changed Attitude toward Decorative Arts

Fortunately, in the last few years a great change has come about in the attitude toward the decorative arts. Our museums are no longer mausoleums of the dead arts of the past. The museums

are becoming one of our most important types of educational institutions, with exhibitions of the decorative arts drawing vast crowds of people. The best art schools are in tune with, or leading this movement, and the decorative arts are no longer classed as unimportant or as an activity for the working classes.

Contributing to this change in viewpoint has been the almost complete change in viewpoint toward education in general. It is not such a long time ago that education was considered a preparation for either a life of leisure or at least our leisure moments, instead of a preparation for life itself.

Weaknesses in Schools

At the root of much of the weakness in our schools is the evil desire for quantity and size rather than for quality. Success has been measured too much by the number of students rather than by the caliber and value of their service.

Our educators leave themselves open to criticism on moral grounds if they establish schools, departments, or courses which are inadequate in training students for the intended rôle in life. If not on moral grounds, then they are open to the criticism of a lack of judgment. To almost the same degree, they must be blamed if they allow a school to grow beyond a point where the graduates can be absorbed in the field for which they are prepared. To take from any boy or girl four years out of the best part of his life and *waste* it in training for a specific occupation is a great responsibility, not to be taken lightly.

As a part of this responsibility, a grave error is made in allowing students without natural talent to get into art work of any kind. When a young man enters a large industry to do design work, in order that his work prove successful, it must be considered as being truly competitive in a national sense. The boy whose talent is only sufficient to be noticed in his own local community should not be considered good material to do work which must prove its worth over the whole country. To accomplish anything in art work requires a natural talent, good instruction, and hard work. Students without the requisites should not be allowed to continue.

It is to be hoped that our ceramic schools will not make the mistake of attempting to establish industrial art courses without due thought as to the actual requirements. It will be a difficult task to bring these schools up to the level of our better art schools. Unless plans to that end are competent, the effort will be a failure.

Our schools here do not have thousands of small ceramic industries to take up and use students of ceramics whose ability is but of average caliber. Due to the concentration of American industry into large units, with their production unlimited in its tonnage but very strictly limited in the variety of designs, it is only too true that we have no time to bother with designers whose ability is anything less than the very best.

European Schools

In the closer relation of art and education to industry in Europe there is much that we can learn. It is futile to believe that we can slavishly copy that which some other land has found effective. While we may not copy, at least we may adapt. Taking as examples the ceramic art schools of Berlin and Vienna, we find an almost ideal combination of circumstances. These are as follows: (1) The outstanding talent in ceramic art of the country does the teaching. These men are designing for industry and producing art ware for sale together with teaching. (2) They are departments of the leading art schools of their countries. This means that they have behind them the outstanding talent in all forms of art. (3) It means that to these schools flock the youths of outstanding genius in the country. Here they secure the most capable instruction and, as students, produce for exhibition and the market.

There is but little that we in America can find that compares favorably with the foregoing conditions. Our ceramic schools are not in combination with our better art schools. The students with the greatest genius go to the better art schools. In such schools they receive the best of instruction and the result is good art work. Unfortunately, in our ceramic schools, we have not secured students of a high degree of natural talent and they have not had instruction under teachers comparable to those in our better art schools.

IV. CONSTRUCTIVE SUGGESTIONS

The following suggestions are made with the hope that they will be constructive, thereby justifying some of the frankly critical preceding statements.

We should first consider the problem of education, the source of many of our other problems. Some of the faults we have to correct are obvious; obvious because as a comparison we have the relatively successful ceramic engineering departments in the same schools and the unquestioned success of some of our better American art schools in fields other than ceramics.

In a four-year ceramic art course, it is impossible to train professional artists and at the same time good potters, glassmakers, or enamelers with technological background. When, in addition, students are expected to acquire some liberal arts education, the task is hopeless.

In order to compete with our better art schools, something equivalent to their methods must be adopted. The successful art schools keep at the serious business of art training throughout the entire course. They spend but little time on general educational work and are, therefore, looked down upon by our universities.

The alternatives before our universities are these: (1) If they can not give a degree to the student completing an intensive four-year art course, leaving out the technological and liberal arts work, they could at least give a certificate for the successful completion of such a course. (2) They could have the course cover a six-year period. This is a questionable procedure for the reason that six years under the influence of one group of men is unhealthy in the growth of art talent; most artists would agree on this point.

Our ceramic art schools can render the best service when they function for the purpose of graduate study. An effort should be made to enroll a limited number of really talented graduates from the best art schools. Those of mediocre ability will be only a liability. Several fellowships a year to talented students would be an excellent national investment.

In two particulars, the ceramic schools must follow the leading art schools. The first of these is in giving solid unbroken time for work in the essential subjects such as design and modeling and to the application of art in ceramic materials. Such subjects as require one-hour class periods must be so grouped as not to interfere with these essential subjects.

The second has to do with faculties of the schools and their activities. In order that students' work shall assume professional standards, the pace must be set by the teachers. They must not only be capable of doing professional work but they must actually be doing it in connection with teaching. Some of the best art schools limit their teachers to a maximum of three days a week of teaching, requiring that in the remaining time they prove their ability in outside work. When schools burden teachers to the point where this is impossible the purpose of the school is defeated.

Carrying out this idea, the ideal condition to establish from the "fine art" ceramic viewpoint would be to have, in connection with the school, operating units where ware is produced to be actually marketed. The French national ceramic school is on the same grounds and a part of the famous Sèvres pottery. In Germany and Austria, the schools are in themselves actual producing plants on a small scale, making ware for the market and for exhibition. In some of them, a large part of the teacher's income is derived from marketing the students' work.

To carry out completely this idea, in order to teach industrial ceramic art, the faculty should bring to the school the actual problems of industry which they are helping to solve. Only in this way can students and teachers keep in touch with new materials, new methods, and competitive standards of quality and style.

In section III, criticism was directed toward the field of public-school pottery work. There is no doubt of the fascination which clay has for both children and adults and that it is an interesting method by which to carry out art projects. When and if the expense is justified there are ways in which the work can be carried on in a more legitimate fashion than is common. There are instances of legitimate work, such as shown in the last National Ceramic Art Exhibition, in which examples of children's work from Hull House were so good as to merit an "Honorable Mention" in competition with the best work of our adult potters. The pieces exhibited were in the field of ceramic sculpture and, while somewhat naive and childlike, were interesting results of keen observation. The interest in the work was almost entirely that of the child and not of the teacher who did the glazing and firing. By a study of suitable techniques for school use and the development of better and more suitable raw materials, a large part of the criticism can be lifted from this field of work. This will require a separate study in itself, and merits the attention of those capable of doing the work.

V. CONCLUSION

The most stimulating influence which can be brought to bear upon all the decorative arts, including the ceramic arts, consists of an increase in the number of small industries making art ware. There must be the provision, however, that they be guided in the direction of making highly individualistic and creditable products for the limited markets. The purpose of a program to this end would be based largely on a desire to counteract the *evils* resulting from an increasing *concentration* of industry into large units. The *tendency to concentrate* may be granted as unavoidable. The *evils* can be avoided, if we so desire.

The greatest of these evils lies in the limited, ever-narrowing range in variety of product offered to the buying public. If concentration of industry and limitation of variety should continue into the future, buyers who wish individuality will be even more dependent than at present on foreign ware.

By a continuation of this tendency, industry will lose one of its main sources of stimulation. There is no doubt that new styles and improvements in taste are brought about, for the most part, by the individual craftsmen and small shops. To lose this influence can have nothing but an evil influence on American industry. There would remain nothing then as a source for new ideas except foreign ware. That this foreign influence has been too strong in the past is a matter of common agreement. With nothing but a foreign source, the development of a truly American art is impossible. So also will there continue a disrespect for American products and a consequent lower market price as compared to foreign merchandise.

There will be a constantly lessening opportunity for American artists and craftsmen under such conditions. Large industry will lose because the small industries provide an unexcelled method of developing personnel. Concentration will, therefore, affect and limit the opportunities of students from our schools, and at the same time limit the choice of large industry in finding talent for its development work. In a consideration of this point, it must be remembered that quite often the greatest talent develops but slowly and often outstrips that which seems the most brilliant in the beginning. Nothing can equal the small organization in developing ability or in absorbing those of less than brilliant promise.

The good which can come from the increase in number of small industries is great; it deserves the study and the assistance of our great industrialists, as well as of our great merchants. The benefits to the pocketbook of business, to the opportunities for our students and to the fullness of American life, in general, should be sufficient incentive for a concerted effort to this end.

Onondaga Pottery Company
Syracuse, N. Y.

DISCUSSIONS

Marion L. Fosdick:† The following is a brief summary concerned only with educational values. A discussion of Mr. Cowan's entire paper is not intended or practicable due to space limitations.

A program of ceramic art such as Mr. Cowan outlines is easily endorsed. It is to the best interests of industry and education to bring it about. Modification according to the set-up of each school would not greatly change it. Its tenets are excellent. Its plan has been very thoughtfully conceived. At Alfred, now that our objective has been changed to industrial design, we are using these suggestions in our revised course which commences with this year's entering class. The course in art is now an industrial ceramic design course, painstakingly developed with the most competent advice.

It seems that what concerns ceramic art education in the future is of vital interest. One questions the need of Mr. Cowan's criticism of its past. Our experience has been that of steady growth in discovery and in the assembling of information, and it has had a wide-spread influence in a pioneer field of training. The foundation is laid. It remains to build on this foundation to meet the needs of industry.

Beginning early in the century, European industry's attitude toward the possibilities of creative design in quantity production has advanced rapidly. European schools in their relation to industry began and have kept ten years ahead of the United States. Their problems are of a different nature from ours. So much has been said and written of them that detail is unnecessary. In the United States, we have absorbed some philosophy from them and we have imitated at times, without thought, some of their developments. At the present time, however, I believe our industries are more sure of what they want in ceramic design and are showing it in the fine accomplishment of well-known designers.

A question of the future is whether a ceramic designer will receive more adequate training if he first attends an art school for several years and then is exposed to the understanding of clay and of factory procedure by admission to an industrial plant, or whether his training is better if acquired in a ceramic college.

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To judge this fairly, some of the conditions in either case should be alike. The four-year course in any profession is inadequate as to time for maturing. It is not long enough to turn out a product at once valuable to its profession. This situation has been met in ceramic engineering by such firms as Westinghouse, who takes a man as a liability for a year after graduation, realizing that the theory he has been taught, though based on others' experience, can not be practical without his own experience. Let us grant the limitations of any four-year course and the opportunity, on graduation, of entering a plant for a year's experience. Let us grant coöperation between industry and the schools, with the most generous, impersonal interest in the issue at stake. Then which is better as a foundation, art or ceramic school training?

It seems to me that no amount of paper design in an art school can equal a course which includes the individual survey of reactions of clay and its associated raw materials at high and low temperatures. That is the content of our present ceramic art course. It is a survey course in ceramics with intimate experience on the student's part through certain esthetic and research problems. Not all that we are doing at present will be carried on in the new course. The graduate will know definite advantages and limitations in ceramics so that his design for ceramic ware will cooperate with the plant technician and not be discouragingly impractical. Following his understanding of his material, the experience in a ceramic plant may be mutually beneficial.

An art school course can not give this sympathetic relation to the material. After four years of an art school, plant experience is understandable only so far as information pertaining to that particular product is involved.

What the art school gives, however, of freedom in drawing, design, and modeling is so necessary that in the new course we are concentrating on those subjects for half the course. With the exception of chemistry and English, the students' time will go to the fundamentals of art. In the two final years, ceramics will be stressed along with design and drawing.

At present, the teaching schedule is so heavy that satisfactory time can not be given to industrial contacts on the part of the faculty through individual work. This is a part of the more ideal program and should be secured as soon as possible. As to the number of students registering for the course in contrast to the ideal requirement of the talented few, it is planned that only the most desirable will be advised to keep industrial design as a goal. The department has a scholarship requirement for continuance in the course. Numbers of students, however, can meet this requirement who are attracted to the course with a rather vague idea of what their futures will be. This is one of the problems which economically and practically needs solution.

Granting these problems and other limitations, however, the course has been incorporated hopefully as an intelligent solution of the future. Mr. Cowan's advice, based on his experience, has been valuable and it is the further object of this description of the course to ask also for suggestions from others interested. It is not alone an industrial matter. It is not alone an educational matter. It will require revision. At present, however, it is a sincere effort toward a very definite goal.

ARTHUR BAGGS:* Mr. Cowan has given an excellent paper which is carefully thought out, severe but fair in its criticism and constructive in its suggestions.

Fundamentally, I agree with his conclusions. The longer I attempt to teach ceramic art, the less I feel that I know how it should be done. Teaching is experimental work. I have been trying out things for several years, but I am not yet qualified to give advice about a definite curriculum. I have discovered what all teachers know, that a student with exceptional ability and willingness to work hard will grow and develop and become a useful person, no matter who his teachers are or in just what way information is fed to him. If our schools were made up entirely of this type of students, we teachers would feel less futile. But how can we take the casual, course-passing individual who has no particular urge or ability or industry and turn him into a potential industrial designer? I do not know.

As our schools are set up at present, we have to face the fact that few of the people we get to work upon are of that rare sort who will go ahead under their own steam. How are we to supply to the majority of our students this steam, plus the knowledge they need, plus habits of hard work, plus the elusive thing called taste or design instinct or what you will? Can any teachers or any system of carefully arranged courses give these things to the average "run-of-the-kiln" student so thoroughly that he or she will magically become a valuable industrial designer or a first-rate individual craftsman or teacher? Again, I do not know.

If an ideal school could be founded where carefully selected students could be intensively trained in ceramic art, a somewhat higher average product might be expected. But we can not do that. We must take them as they come and try to make them useful. We teachers are trying. We are conscious of the urgent need to improve our results. We are eager to receive help and constructive suggestions.

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NOTES ON DRAINING OF GROUND-COAT ENAMELS FOR SHEET STEEL*

By Murray C. Gautsch

Abstract

Some observations of the effect of atmospheric conditions and other factors on the draining behavior of ground coats are given. In cold weather the enamel broke after draining, while in hot weather the enamel "lost its set." The undersmelting of the frit also had a tendency to make the ground coats lose set. Preceding a violent thunder-storm, ground-coat enamels which had previously been working well, completely lost their set. To overcome ground-coat draining difficulties, standards should be set up for smelting, grinding, aging, and temperature control of the enamel.

I. Introduction

Over a long period, it was noted that the draining of ground coats would become irregular from time to time. Obviously, weather conditions influenced the behavior of the slip, since the inconsistencies usually came in periods of extreme heat or cold.

II. Effect of Temperature on Enamel Storage

In periods of cold weather, it was observed that the ground coat had a tendency to break after the ware had finished draining. The only deviation from usual conditions was the temperature of the room in which the enamel was stored, which was about 40° to 50°F. The temperature of the shop was about 50°F during the night. When the ground coat was stored where the temperature was approximately 70°F at all times, the draining trouble disappeared.

In the summertime, when the slip was set heavy enough so that a proper coating of one and one-eighth ounces per square foot of enamel was applied, ugly drain marks and V-shaped irregularities appeared; on flanged ware, the enamel hung badly on the flanges; after the ware was fired it had a rough, singed appearance. When the slip was thinned to remedy this defect, the enamel drained thin at the top so that, when fired, the top of the piece would be badly overfired, while the bottom would be barely finished. In other words, the enamel had "lost its set." This tendency of the enamel was greatly increased with long aging time of the ground coat.

To determine the effect of temperature on the draining properties of ground coats, strips 3 by 18 inches were dipped in ground coat which had been milled for use in production and had been aged 24 hours before dipping. Two plates were run at each of the following temperatures.

Temperature (°F)	Draining Properties
55	Quick initial set; tendency to break
60	Quick initial set; did not break
65	Good
70	Very good
75	Very good
80	Tendency to V-drain
85	Drain thin at top; slight V-drain
90	Drain thin at top; badly V-drain
95	Drain thin at top; badly V-drain

The enamel which was used through this temperature range was allowed to stand 18 hours and dipped at a temperature of 70°F. The enamel drained with bad V-marks and was thin at the top of the piece showing that the enamel had completely lost its set.

III. Temperature of Frit Smelting

The smelting of ground-coat frits also plays an important part in the draining of the enamel. Through error, the ground coat was smelted at a low temperature. Enamel made from this frit showed a tendency to lose set as described before. As soon as the correct smelting temperature was adhered to, the trouble disappeared.

From the data which have been given, it is evident that the amount of soluble material in the frit is one of the controlling factors in the draining properties of the ground coat.

IV. Effect of Thunder-Storm

Atmospheric conditions have been noted on two occasions as having a probable effect on the draining of ground coats. A dipping tank of enamel which had been set at standard weight completely lost its set during a half-hour period preceding a violent thunder-storm. Additions of heavy enamel had no effect on bringing the slip back to the desired consistency. Following the storm a

* Presented at the Annual Meeting, American Ceramic Society, Buffalo, N. Y., February, 1935 (Enamel Division). Received April 10, 1935.

small addition of heavy enamel gave a satisfactory result. The atmospheric conditions during this period were extreme, with high humidity, falling barometer, and a temperature between 95° and 100°F, although it had been as hot for four hours preceding the incident.

V. How to Regain Set of Ground Coat

When a ground coat loses its set, it may be reclaimed by milling with an addition of one ounce of sodium aluminate per one hundred pounds of frit or by the use of other suitable electrolytes. The most satisfactory way to overcome draining troubles is to set up definite standards for smelting, grinding, aging, and temperature control for slip, and then to adhere strictly to the established standards.

Baltimore Enamel & Novelty Company
Baltimore, Maryland

DETERMINATION OF CALCIUM SULFATE, AS SUCH, IN CLAYS*

By Charles A. Peters

Abstract

This article shows how to determine calcium sulfate directly by evaporation and weighing without chemical change.

I. Introduction

In connection with the problem of scum on ceramic ware, it becomes necessary to determine calcium sulfate in clay. Obviously, a direct determination, as such, is better than the separate estimations of calcium and sulfate ions, as the calcium determination may include lime as carbonate; the sulfate determination may include magnesium and other soluble sulfates.

This paper outlines a method for the direct determination of calcium sulfate in clays by the evaporation of its solution and the weighing of $CaSO_4$ directly, without any chemical change.

II. The Method

An amount of clay, depending somewhat on the quantity of calcium sulfate suspected, about 100 grams, is put into a liter flask, the flask is filled to the mark with distilled water, and the whole is well shaken and allowed to settle. A simpler way, taking more time however, is to pour off enough to fill a 500-cc. wide-mouth bottle and again allow the sediment to settle (which may take all night). Cover the bottle with a glass plate to prevent evaporation. When settled, filter off enough liquid to fill a 500-cc. graduated flask. The 500-cc. wide-mouth bottle will hold more than 500 cc. so that it will be possible to get the desired quantity from it without disturbing the sediment. The liquid may not be clear, as the clay may not entirely settle, depending on the soluble salts present.

Transfer the measured 500 cc. of liquid to a beaker on an electric hot plate and arrange a jet of air across the surface to hasten the evaporation. As the water evaporates and the salts concentrate, the clay particles will coagulate and may be filtered out and liquid may be returned to a 250-cc. beaker. One filtering at the right time is generally enough to remove the excess clay. The microscope will easily reveal whether the precipitate forming is clay coagulating or calcium sulfate forming. When the liquid is reduced to a small volume it is examined under the microscope from time to time for calcium sulfate crystals, the drops of liquid used being washed back into the beaker after examination. The crystals appear as planes radiating from a center or as one plane growing obliquely out of the flat side of another. (Pictures are common in the texts.) When the ready appearance of crystals indicates that the solution is saturated, a few drops of sulfuric acid are added and the solution, after cooling, is diluted with 4 volumes of alcohol and allowed to stand over night. After filtering on asbestos, washing with alcohol, and gently igniting the precipitate, the calcium sulfate is weighed.

If 100 grams of clay be used, the amount found should be multiplied by 2 and again by 0.96 to make up for the volume occupied by the clay.

* Received October 27, 1935.

Magnesium may be determined in the alcoholic filtrate by the usual phosphate precipitation.

III. Application

To show how applicable the process is, clay from a brick-yard was examined for calcium sulfate; then 100 grams from the outside of an unfired brick, made from the same clay, taken from a drier heated by cooling kilns, was likewise examined. A mixture of 50 grams from an end and 50 grams from across the middle of an unfired brick from the same drier was again analyzed for calcium sulfate. By calculating the amount of calcium sulfate on an end of a brick from the total surface and adding to that the calcium sulfate in 100 grams of clay, the amounts were practically the same, indicating that the process is capable of yielding accurate results. The figures follow.

	$CaSO_4$ (grams)
100 grams from outside dried brick	0.3281
One end (calculated) 10.62/136 of above	0.02563
100 grams of clay from brick-yard contained	0.02765
Total	0.05328
Actually found	0.05434
Difference (probably due to calcium sulfate on outside surface exposed on the 50-gram middle portion)	+0.00106

Goessmann Chemistry Laboratory
Massachusetts State College
Amherst, Massachusetts

ACTIVITIES OF THE SOCIETY

NOMINEES FOR OFFICES OF AMERICAN CERAMIC SOCIETY FOR 1936

FRANCIS C. FLINT

Francis C. Flint

Francis C. Flint, Vice-President of the American Ceramic Society for 1935, and sole nominee for President of the Society for 1936, was born in Chicago, Illinois, November 29, 1890. He was graduated from high school in Long Beach, Calif., in 1910. In 1915 he received the B.S. degree from Pamona College, Calif.

From 1917 to 1919 he was employed by E. I. duPont Company. In 1919 he joined the Hazel-Atlas Glass Company. He is now Chief Chemist and Director of Research for this Company.

Mr. Flint has held a number of offices in the American Ceramic Society, serving as Trustee of the Glass Division in 1923, and Chairman of the Division in 1926.

He is also a member of the Society of Glass Technology, and has served as American treasurer of this society since 1926. In addition he is a member of the American Chemical Society and the American Institute of Chemical Engineers.

His publications are as follows:

The Journal of the American Ceramic Society

"Feldspar for Glassmakers," **6** [2] 413–16 (1923).

"Insulation of Glass Tanks," **7** [6] 462 (1924).

"Checker Brick for Resisting Alkaline Slags," (with M. C. Booze), **7** [8] 593–98 (1924).

"Tank Block Corrosion by Shelving," (with A. R. Payne), **9** [9] 613–17 (1926).

"Flow of Glass in Tanks," (with A. K. Lyle), **15** [8] 410–18 (1932).

Journal of the Society of Glass Technology

"Statistical Methods for the Routine Testing of Bottles," (with A. K. Lyle), **16,** 360–72 (1932).

The Bulletin of the American Ceramic Society

"Colloquium on Feldspar Specifications," **2** [7] 224 (1923).

"Effect of Selenium Decolorizer on Tank Blocks," **3** [9] 338–39 (1924).

"Glass and Refractories Symposium," **4** [11] 610 (1925).

"Test for Chemical Resistance of Glass Containers," (with A. K. Lyle), **12** [10] 296–99 (1933).

Robert B. Sosman

ROBERT B. SOSMAN

Robert B. Sosman was born in Chillicothe, Ohio, in 1881. In 1903 he was graduated from Ohio State University, receiving the B. Sc. degree. From the Massachusetts Institute of Technology in 1904 he received the degree of S.B. and three years later that of Ph.D.

From 1906 to 1908 he was employed at the Arthur D. Little Laboratory in Boston, Mass.

He served as physicist in the Geophysical Laboratory, Carnegie Institution of Washington, between 1908 and 1928. In 1928 he became assistant director and physical chemist, United States Steel Corporation Research Laboratory, Kearny, N. J.

During 1918 he was consulting chemist, Ordnance Department, U.S.A. He also was lecturer on geophysics, Massachusetts Institute of Technology in 1925–1926.

He is a Fellow of the American Ceramic Society, American Association for the Advancement of Science, American Chemical Society, American Physical Society, American Institute of Mining and Metallurgical Engineers, American Iron and Steel Institute, Geological Society of America, and the Washington Academy of Sciences. He was President of this last organization in 1928.

He is also a member of the English Ceramic Society, and the Deutsche Keramische Gesellschaft.

In 1927 his work, The Properties of Silica, was published. In addition, he has published papers in scientific periodicals on high-temperature thermometry, refractories, mineral chemistry, and physics.

At the 1933 Meeting of the American Ceramic Society he was Chairman of the Symposium on the Physical Chemistry of the Alumina-Silica Refractories. At the 1934 Meeting he was Chairman of the Symposium on Crystalline Substances in Refractories, taking the place of the late Edward W. Washburn.

In 1934 he was elected Trustee and Vice-Chairman of the Refractories Division of the American Ceramic Society. He is also a member of the Editorial Committee of this Division. In 1935 he served as Chairman of the Refractories Division.

He is the sole nominee for the position of Vice-President of the Society for the year 1936.

C. FORREST TEFFT

C. Forrest Tefft

C. Forrest Tefft, nominee for the office of Treasurer of the American Ceramic Society for 1936, was born in Belmont, N. Y., in 1889. He studied at the New York State School of Ceramics in 1908 to 1909 and from 1911 to 1914, receiving the degree, B.S. in Ceramics, from Alfred University.

During the period from 1900 to 1911, Mr. Tefft was employed by the Ludowici-Celadon Company at Alfred, N. Y., and Coffeyville, Kansas. In 1914 to 1915, he was superintendent of the Ridgway Brick Company, Ridgway, Pa. For the next five years he was manager of the Darlington Clay Products Company, Darlington, Pa.

Between 1920 and 1924, he was assistant factory manager of Fiske & Company, Inc., Watsontown, Pa., and in 1924 he became factory manager.

Following a year of work as consulting ceramic engineer, Mr. Tefft was made general factory manager of the Claycraft Company, Columbus, Ohio. Three years later, in 1929, he became General Manager of this Company, which position he still holds.

Mr. Tefft joined the American Ceramic Society in 1913, becoming an Active Member in 1920. He is also a Fellow of the Society. He has held several offices in the Society, having been Secretary at the organization of the Heavy Clay Products Division in 1921, and Chairman of the Division in 1922. He was Trustee of this Division from 1924 to 1926. Mr. Tefft has been connected, as trustee or officer, with the Ohio Ceramic Industries Assn. since its origin. He is also an honorary member of Keramos.

Mr. Tefft's published papers are as follows:

Transactions of the American Ceramic Society

"Roofing Tile Slips and Glazes," (with E. T. Montgomery), **16**, 144–50 (1914).

Journal of the American Ceramic Society

"Items Requiring Consideration in Underground Clay Mining," (with R. H. Hearing), **10** [11] 919–23 (1927).

"Development of the Shale Planes," **11** [10] 785–90 (1928).

H. B. HENDERSON

H. B. Henderson was graduated from Ohio State University in 1904 with the degree B.Sc. and worked as iron and steel chemist until 1906 when he was employed by the late Edward Orton, Jr., in his cone business, known as the Standard Pyrometric Cone Co., Columbus, Ohio. He was intimately associated with Dr. Orton, up to the time of the latter's death in 1932, in the development and manufacture of pyrometric cones.

Following a connection as superintendent of the Standard Pyrometric Cone Co. for twenty-eight years, he resigned in 1934 and organized H. B. Henderson & Co., New Brighton, Pa., specializing in the manufacture of pyrometric cones and technical service in connection with the proper use of cones.

Mr. Henderson is a Fellow of the American Ceramic Society and has been Treasurer of this organization since 1923. He is author of a number of ceramic technical papers which have appeared in publications of the American Ceramic Society, *Ceramic Age*, and other journals.

Mr. Henderson is one of two nominees for the office of Treasurer of the American Ceramic Society for 1936.

H. B. Henderson

MEMBERSHIP STATUS

	November 20	December 31
Paid In Full		
Personal	1221	1248
Corporation	186	187
Honorary, Life, and Complimentary	26	26
Deferred personal	29	26
Part-payment personal	50	46
Subscribers	444	488
Advertisers	35	37
Current Sales	225	225
TOTAL	2216	2283

NEW MEMBERS

Corporation

ARTHUR G. MCKEE & Co., J. P. Irwin, voter, 2422 Euclid Ave., Cleveland, Ohio.

Personal

BURTON, DAVID, Pilkington's Tile & Pottery Co. Ltd., Clifton Junction, Manchester, England; managing director.

CHURCH, MARSHALL T., Box 1432, Ancon, Canal Zone, Panama; manager, Clay Products Co., Inc.

DE BROCK, A., Terminal House, Grosvenor Gardens, London, S.W. 1, England; Parkingson Stove Company.

FRANK, HENRY A., Kokoma Sanitary Pottery Corp., Kokomo, Ind.; superintendent.

FRAUTSCHI, ROBERT F., Y.M.C.A., Alton, Ill.; Owens-Illinois Glass Co.

HISSCHEMÖLLER, FREDERIK W., Rynlaan 227, Utrecht, Netherlands; ceramic research engineer.

HUNTER, R. G., Owens-Illinois Glass Co., Alton, Ill.

JONES, CLIFFORD, 11 Beech St., Fairfield, Liverpool, England; work manager, Liptals Furnace Arches, Ltd.

NIJHAWAN, KRISHNA K., Tata Iron & Steel Co. Ltd., Jamshetpur, India; refractories laboratory.

POOR, MARY ELEANOR, 28 W. 53d Terrace, Kansas City, Mo.; saleswoman, T. N. James & Sons China Co.

RALSTON, OLIVER C., Bureau of Mines, P.O. 56, Highland Park, New Brunswick, N. J.; supervising engineer, Nonmetallic Minerals Experiment Station.

TASKER, H. H., Ideal Boilers and Radiators Ltd., Hull, England.

WATSON, WILLIAM, John G. Stein & Co. Ltd., Manuel Works, near Linlithgow, Scotland; firebrick plant manager.

WILSON, EARL O., Yenching University, Peiping, China; professor of industrial chemistry.

Student

COFFEEN, WILLIAM W., University of Illinois.

CUDNEA, PIERRE, Cleveland School of Art.

MADDEN, ROBERT H., University of Alabama.

MYERSON, MARTIN, Massachusetts Institute of Technology.

WILLIAM J. McCAUGHEY TO GIVE 1936 EDWARD ORTON, JR., FELLOW LECTURE

"Contribution of Mineralogy to Ceramic Technology and Ceramic Research" Is Subject

William J. McCaughey, Chairman, Department of Mineralogy, Ohio State University, will deliver the 1936 Edward Orton, Jr., Fellow Lecture, Tuesday night, March 31, at 9:00 o'clock, during the Thirty-eighth Annual Meeting of the American Ceramic Society, March 29 to April 4, at Columbus, Ohio. His subject is "Contribution of Mineralogy to Ceramic Technology and Ceramic Research."

Dr. McCaughey was born in Philadelphia, June 21, 1882. He received his B.S. degree from the University of Pennsylvania in 1906 and his Ph.D. from George Washington University in 1912. In 1910 he was a part-time graduate student in geology and petrography at Johns Hopkins University.

From 1908 to 1911, Dr. McCaughey was a soil scientist and mineralogist of the U. S. Bureau of Soils. He was Assistant Professor of Metallurgy and Mineralogy, Ohio State University, from 1911 to 1916, and in 1916 he was made Chairman of the Department of Mineralogy.

Dr. McCaughey is a member of the American Chemical Society, the American Institute of Mining Engineers, the Deutsche Mineralogische Gesellschaft, Fellow of the American Geological Society, the American Mineralogical Society, and the American Association for the Advancement of Science. He assisted in editing the *Transactions of the American Ceramic Society* from 1912 to 1916, inclusive.

Previous Fellow lectures have been the late Edward W. Washburn, who was Chief Chemist, National Bureau of Standards, Washington, D. C.; Arthur L. Day, Director, Geophysical Laboratory, Washington, D. C.; and H. Ries, Head of Department of Geology, Cornell University, Ithaca, N. Y.

William J. McCaughey

IS STAINED GLASS A LOST ART?

Art Division Plans Unusual Lecture for Annual Meeting

Lawrence Saint, who was for seven years director of the Stained Glass Department, Washington Cathedral, Huntingdon Valley, Pa., is to address the Art Division of the American Ceramic Society on the subject, "Is Stained Glass a Lost Art?" at the Thirty-eighth Annual Meeting of the American Ceramic Society, Columbus, Ohio, March 29 to April 4, 1936.

Mr. Saint served a three-year apprenticeship in stained glass, and studied three years at the Academy of Fine Arts, Philadelphia, Pa. While studying there, he won a European scholarship and has since then been to Europe five times to continue his studies.

He has invented furnaces, rediscovered a way to reproduce a copper ruby approximating that of the 13th Century, and made, with the help of expert chemists and glassmakers, thirteen hundred formulas for stained glass colors.

He has also discovered a way to make glass paint like that of ancient times.

He has designed and made the figure cartoons and glass formulas for thirteen windows in Washington Cathedral, including the North Transept Rose Window and the Parmelee Windows beneath it.

Several of the slides used to illustrate Mr. Saint's lecture are taken from the fifty color-illustrations which he made for the book, Stained Glass of the Middle Ages in England and France.

Included in the illustrations Mr. Saint will show are color photographs, photomicrographs, color-harmony and light-refraction charts, and photographs dealing with historical and technical phases of the art of stained-glass production.

Another unusual feature of some of the slides is that they contain fragments of glass made seven hundred

years ago. These fragments are enlarged on the screen, affording an opportunity for close study of the way in which their color effects are produced.

Mr. Saint has published articles in such journals as *Cathedral Age*, *Stained Glass*, and the *Journal of the British Society of Master Glass Painters*.

His work was chosen by the Metropolitan Museum of Art, New York, for a three-reel educational moving picture on stained glass, called "The Making of a Stained Glass Window."

ENAMEL DIVISION

Amendments to the By-Laws[1]

IV. Officers

Article 1 has been changed to read (beginning third sentence): "The officers and two of the councilors of the Division shall be elected annually at the last session of the Division held during the Annual Meeting of the Society, the officers for one year and the councilors for two years. The officers and councilors shall take office at the close of the Meeting at which they are elected. Two of the four councilors shall be holdovers from the previous year. The Chairman shall not be eligible for immediate reëlection."

Article 2 has been changed to read: "All vacancies occurring during the year shall be filled by appointment by the Chairman, subject to the approval of the Executive Committee. Should the Chairmanship become vacant, a new Chairman shall be chosen by the Executive Committee, the Division Secretary conducting the poll. The new Chairman so chosen shall not forfeit the privilege of election to succeed himself at the next regular election of officers."

VI. Division Nominating Committee

Article 1*a* (beginning last sentence) has been changed to read: "The nominations shall be announced to the Division by publication in the *Bulletin of the American Ceramic Society* in an issue not later than that of the month preceding the Annual Meeting."

VII. Standing Committees

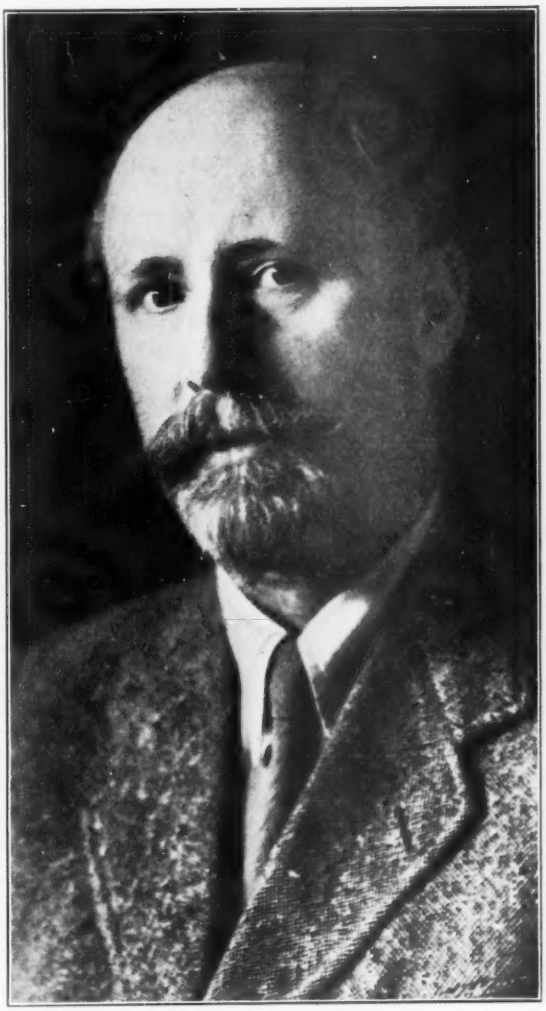
Has been changed to read: "The following Standing Committees shall be appointed each year by the Division Chairman: Membership, Rules, Standardization of Tests, Research, Data, Education, and the Committee on Program and Papers. The Chairman of each of these Committees shall act as the Division representative on the Society's General Committee."

VIII. Special Committees

Has been changed to read: "The Chairman of the Division shall appoint such additional committees as he may deem necessary. The appointment of the Chairman of each special committee shall be subject to the approval of the Executive Committee of the Division,"

—B. J. Sweo, *Secretary*

[1] For original By-Laws see *Bull. Amer. Ceram. Soc.*, **10** [12] 349 (1931).



Lawrence Saint

MEMBERSHIP WORKERS' RECORD

Corporation		T. W. Talwalker	1
J. M. McKinley	1	A. S. Watts	1
		Office	6
Personal			
R. S. Bradley	1	**Student**	
G. H. Brown	1	A. I. Andrews	1
P. E. Cox	1	Mrs. A. R. Dyer	1
W. L. Fabianic	1	T. N. McVay	1
J. E. Hansen	1	F. H. Norton	1
G. G. Hanson	1		
		Grand Total	**19**

OUR MEMBERS ARE CHEERFULLY PAYING

I am enclosing herewith a check for my Society dues for the forthcoming year. I receive a great deal of pleasure as well as assistance from my membership and I hope to attend the Annual Meeting at Columbus this year.—John C. Reimers

PROBLEMS FOR RESEARCH ON REFRACTORIES*

I. INTRODUCTION

It has been the effort of this Committee to formulate problems, the working out and publication of the results of which would be currently helpful to the widespread understanding of fundamental properties of refractory materials. The development of these problems would probably result, in some cases, largely in correlations of existing data, and in other cases, in the production of new data.

It is hoped that this set of recommended problems may prove useful to investigators as the basis for plans of research.

II. PROBLEMS

(1) A Critical Survey of Instruments for Research on Refractories

General

Concerning tools for research on refractories we can not do better than quote Sosman[1] as follows:

"Refractories offer a striking example of the fact that the greatest need of research at the moment is an institution for the study and improvement of laboratory apparatus and for the manufacture and sale of items too infrequently called for, or too difficult to make, to have a dependable market."

Types of tools for refractory research and dissemination of knowledge concerning existing tools are at present possibly our most neglected subjects.

Furnaces

One type of tool is the constant temperature furnace. Platinum-wound furnaces for tiny charges, the temperature of which can be rather accurately controlled, now exist. Similar control, however, of coal-, oil-, and gas-fired furnaces, over the range from room temperature to cone 33, is at least not common.

The following items are involved in this subject:

(*a*) Gas-fired research furnaces.
(*b*) Gas-fired industrial periodic kilns.
(*c*) Oil-fired research furnaces.
(*d*) Oil-fired industrial periodic kilns.

Timely and Useful

A critical survey of instruments for research on refractories is especially timely and should be of great interest since, with the growing appreciation of the relation of certain fundamental properties to service, the measurement of some of these properties has resulted in the development and use of apparatus not particularly well known.

This study is headed "For Research on Refractories." However, as soon as a tool becomes established as useful in research on refractories, some form of it is very likely to be used in routine or semiroutine plant tests. The type most suited for plant tests may or may not be like the type most suited for research.

Subject Matter

Whoever undertakes such a survey will have his own ways of subdividing it. The subject matter of such a survey, however, would probably cover (*a*) description and manner of use of available equipment, (*b*) description and manner of use of apparatus described in the literature, and (*c*) needed equipment that is not yet available.

Some of the items that might be covered in such a survey probably would include the following:

(1) Furnaces, particularly controllable furnaces, and controls for them, including ovens suitable for accurate temperature control of sizable samples of ware between room temperature and 1100°C and humidity-controlled types (these for studies of firing properties).

(2) Optical apparatus: (*a*) petrographic equipment, (*b*) X-ray equipment, and (*c*) photographic equipment for photomicrographs and the whites, tans, browns, and blacks of used refractories in place.

(3) Thermal-conductivity apparatus.

(4) Thermal-expansion apparatus, including apparatus which could be used at temperatures above 1000°C, and also graphic methods of coördinating temperature and expansion.

(5) Specific-heat apparatus.

(6) Equipment for measuring volume, particularly the specific volume and porosities of materials of graded sizes.

(7) Humidity-controlled drying units.

(8) Apparatus for measuring extensibility at maximum strain.

(9) Pyrometric equipment, particularly improvements, for use at high temperatures, of both the indicating and recording types.

(10) Flue-gas analysis apparatus and apparatus of both indicating and recording types, particularly those suited for furnace atmosphere studies.

(2) A Study of Used Refractories

Introduction

The physical properties and chemical constitution of refractories at the time they are placed in service are fairly well known, but generally what happens to them afterward is not definitely known. In service, they are subjected to high temperatures, to fluctuations in temperature, to the erosive and corrosive action of slags, and to various other influences. They are exposed for a long period of time to temperatures higher than that to which they are fired. Physical and chemical changes occur

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* Prepared by the Research Committee, Refractories Division: Donald W. Ross, *Chairman;* F. A. Harvey, R. A. Heindl, Stuart M. Phelps, L. J. Trostel, and Gordon B. Wilkes.

Previous reports of this Committee are as follows: the 1929 Progress Report, *Bull. Amer. Ceram. Soc.*, **9** [5] (Part I) 158 (1930); the 1930 Report, *ibid.*, **10** [7] 199 (1931); the 1933 Report, *ibid.*, **13** [7] 188 (1934); 1934 Report, *ibid.*, **14** [2] 87 (1935).

[1] R. B. Sosman, "New Tools for High-Temperature Research," *Ind. Eng. Chem.*, **23** [12] 1369 (1931).

which tend to bring about a condition of equilibrium. Slag absorption introduces other changes.

Data of Phase Diagrams

One of the most powerful tools for the investigation of the changes which occur is the petrographic microscope. The thermochemical studies of the Geophysical Laboratory at Washington, D. C., upon various binary and ternary systems provide a great mass of fundamental data which can be used as a foundation for the interpretation of microscopic studies on refractories taken from service. For many years endeavors have been made to apply these data of the Geophysical Laboratory at Washington to specific problems on refractories; this, however, has not been done comprehensively or systematically.

Specimens

Specimens for such studies with their life histories can frequently be collected by the investigator himself. This is particularly so in the Pittsburgh, Chicago, New Jersey, and Birmingham districts and in the smelter districts of the West.

Microscopic and other investigations of these specimens and the interpretation of the results in the light of the thermochemical studies mentioned should make much clearer just what happens to these refractories in service. Through such studies the manufacturer should be aided in the development of materials more nearly suitable for specific purposes than at present, and the user aided in the selection of the most suitable materials.

Life Stages of Refractories

The following are considered to be the stages in the life of a refractory: (1) the condition existing when it is placed in the furnace, (2) when it has become seasoned in use, and (3) when it is worn out. Condition (1) is usually fairly well known; conditions (2) and (3) are, in general, understood vaguely or not at all. More is known about the effects of service upon silica refractories than upon clay, diaspore, chrome, or magnesia. Silica is a simple oxide and the properties of the silica system of minerals is fairly well known. Studies of used silica brick, while not easy, are not tremendously difficult. Refractories of a more complex constitution, such as the silica-alumina series, offer more intricate problems. Studies along the line indicated above have been made on fireclay brick from boiler service by the National Bureau of Standards. Similar studies have not been made on used refractories taken from the great majority of furnace types. Such problems require trained men and sustained effort; they embrace a field which is not being adequately investigated and which, we believe, offers a real opportunity for useful research.

The above studies of used refractories might properly include all types of refractories, *e.g.*, fireclay, high-alumina, and silica refractories, basic refractories such as chrome and magnesia, and the new forsterite refractory.

Properties of Used Refractories

A subject on which some work has already been done but which offers further interest is "petrographic study of silica brick in open-hearth roofs from insulated and uninsulated sections."[2]

A subject which bears on slag attack of refractories is "the determination of the nature of the transition layer between commercial glass and walls for use against glass (pots and tank blocks)."

Information of considerable interest and value can sometimes be obtained on used refractories when the service conditions of time, temperature, rate of heat flow, slagging, or loading are sufficiently well known. For instance, the degree to which the theoretical conditions of equilibria, as shown by our phase-equilibria diagrams, have been attained might be estimated. This might be used as a guide by refractories manufacturers to improve their products to produce more temperature-stable forms. The data might also be of value to point out better applications of the present products. Also a knowledge of such data should be of interest to users in the application of refractories to their own special conditions.

Detailed Problems

The above is rather general. Hence, the following more definite problems are listed.

(a) Chrome Refractories

The mineralogical constitution of chromite as an ore has frequently been described and is well known to the geologists and lately to some of the refractories technologists. The changes effected, however, by long heating of the chromite proper and the accompanying silicate impurities, both as separate phases and considered collectively after exposure to the slags and dusts of the basic open-hearth furnace as well as the magnesite and silicate refractories alongside of which the chrome brick are laid, would seem to offer a particularly interesting problem.

Chrome is generally considered a neutral refractory. Probably it is, as most frequently used. But certainly it is not when in contact with appreciable quantities of soda or clay. Some of the questions which remain to be answered follow: What happens to the chromite phase, or the silicate impurities, of chrome brick when exposed to iron oxide and the lime of the open hearth? In particular, how are the original melting-point relationships changed and what mineral phases appear?

(b) Bulk Heads

In open-hearth furnaces, particularly in bulk heads, brick appear to fail through cracking back about two inches from the hot face, this piece eventually dropping into the furnace. This does not appear to be thermal spalling, since temperatures at this point are continuously higher than the range in which the brick would be expected to be sensitive to heat shock. The cause of this cracking and breaking away of the brick would make an interesting problem.

(c) Secondary Expansion

What are the causes of "secondary expansion" of certain types of fireclay brick in use? What causes the exfoliation

[2] For a study of this subject see F. A. Harvey, *Jour. Amer. Ceram. Soc.*, **18** [3] 86–94 (1935).

of the flint clay? The data of secondary expansion should be correlated.

(d) Insulated Refractories

Make a comparison of refractories before and after insulation of the furnaces in which they are used. A considerable difference has already been found in silica brick from furnaces with and without insulated roofs.[2] The comparisons ought to be made with brick of identical type and source used in two furnaces of the same type and doing the same work, one of which is insulated while the other is not. In this connection, a knowledge of the differences in fuel consumption, speed, and quality of product manufactured between the insulated and the uninsulated furnaces should prove helpful. Petrographic studies are proving particularly helpful in this type of problem.

(e) Specific Heat

Make a correlation and, perhaps, determinations of the specific heats of refractories before and after use, particularly checker brick.

(f) Slag Action

Make further studies of slag action, more or less duplicating the work of the A.S.M.E. and the Bureau of Mines on boiler-furnace coal ash, in the field of metallurgical slags.

(3) Fundamental Properties of Refractory Clays

For means of presentation, this subject is subdivided as follows: (1) constitution, (2) fundamental properties of clays that vary with variations of the silica-alumina ratio, and (3) properties of the surface of the ultimate clay particles, *i.e.*, working properties and dispersion.

(a) Constitution

The recent studies by C. S. Ross, Herbert Insley, and others, indicate that possibly the waters of hydration of clay are bound to the alumina rather than to the silica. If this be so, it may give information as to the nature of the surface of the individual clay particles and hence information that should be useful in "casting" studies.

Again, if this be so, and if on dehydration γ-alumina and free silica are formed, the exothermic reaction in the neighborhood of 925°C is probably caused by escape of surface energy from γ-alumina as it is converted into α-alumina, with resultant primary shrinkage of clay. Studies of the shrinkage of clays through this temperature range may lead to a better understanding of the causes of firing cracks.

(b) Silica-Alumina Ratio

There is some evidence to indicate that, at least with soft clays, certain properties vary as the silica- (exclusive of quartz sand) alumina ratio varies. There is a possibility that in passing from high silica to high alumina, specific gravity increases, dry strength decreases, and porosity in the raw state increases.

(c) Properties of Clay Crystals

There is some evidence to indicate that ultimate clay particles are flat plates. Perhaps these plates are a few molecules thick and a much greater number of molecules in other dimensions. Colloidal silica frequently occurs in waters flowing from clay beds. From this fact and the probable manner of diaspore formation, it is not hard to imagine that the ratio of silica groups to alumina groups exposed on the surface of the ultimate clay particles varies greatly from one clay to another and that there are corresponding variations in the physical working properties of the clays.

It may be possible that these variations in working properties are foreshadowed by what is already known concerning colloidal alumina and colloidal silica. Further, in connection with the surface chemistry of ultimate clay particles, if we turn to "casting," we find that the salts that disperse clay are some of the same as are used in keeping silica sols dispersed.

The above remarks give only a hint of the great wealth of fundamental properties that are still unexplored.

(4) The Nature of the Origin of Refractory Clays

General Statement

The oldest rocks known to geologists were apparently sediments or extrusions into or upon sediments. Clays and soils do not now occur in these oldest known rocks, apparently having been obliterated by metamorphism other than weathering. If this be so, clays are apparently the derived products of weathering.

Clays and soils are commonly, perhaps always, formed by some kind of weathering process in contact with water or steam. This supposition would appear to be borne out by the fact that the surface of the moon consists of pumice; there being no atmosphere on the moon and hence no weathering, there are no soils and clays there.

Clays and soils, then, would appear to have a common origin, and studies of the properties of soils should hence lead us to knowledge concerning clays.

One conception of the formation of clays and the colloid matter of soils is that the composition depends upon the conditions of formation and that the conditions of formation are commonly favorable to the formation of a hydrated-silica-sesquioxide compound, in which the sesquioxide is commonly alumina or alumina and iron oxide. Kaolinite is probably one of the most stable of these.

In the case of many soils and clays, which, after formation, are supposed to have been weathered for extended periods, the ratio of silica to sesquioxide is low.

Should it prove true that, on weathering, all clays and soil colloids continuously lose silica, either in colloidal form or in true solution, it may be logical to assume generally that the end point of such weathering is a laterite.

We are primarily interested in refractory clays.

Even in the light of our present incomplete knowledge, we may hazard a guess that refractory clays are derived from materials relatively free from iron, or from materials which received special iron-removing treatment during their formative period.

If the above assumptions are tenable, they serve as a

theory for the origin of refractory-clay compositions extending from compositions somewhat more siliceous than kaolinite to compositions as aluminous as diaspore.

Physical States of Clays

What has been set forth, thus far, perhaps does not account for the various physical states of clays as they are mined.

(1) Galpin and others have shown that where weathering is partially or wholly interrupted and other metamorphic forces enter, secondary crystallization probably takes place, serving to bond the material into a semihard mass.

(2) S. C. Fox, in his studies on the laterites of India, has noted examples of lumps of high alumina laterites which broke away from the tops of slopes and reunited into solid masses at the foot of the slopes.

(3) In cases where colloidal silica is known to be leaching from refractory clays, it is not difficult to conceive that at times this migrating silica can also be deposited as such in other clay, thus serving to bond it into a semihard mass.

These examples are sufficient to point out some of the ways in which the products of weathering become indurated into refractory clays, as we know them.

The preceding statements, then, give a picture of how refractory clays may have arrived at their present chemical composition and how at least some of them may have arrived at their present indurated condition.

Travel of Colloidal Silica and Alumina

Although the travel of silica in clays and soils is apparently very common, and probably usually takes place in the presence of neutral or alkaline conditions, the migrations of alumina and iron are apparently relatively uncommon. In cores where alumina and iron do not migrate, it is possible that the conditions are rather strongly acid, as would be the case in the presence of the strong mineral acids.

A more thorough knowledge of the facts of the nature of the origin of refractory clays should prove useful to geologists having to do with refractory clay deposits and also aid in deciding some of the problems which exist concerning the nature of the surface of ultimate clay particles.

(5) Specific Heat of Refractories

It would seem that some valuable work might be done on the specific heat of refractories, not only of various types as manufactured, but also after they have been in different types of furnaces, to prove the effects of heat treatment and furnace contamination. There is a surprisingly small amount of worth-while data available on the specific heat of used refractories.

Correlation Should Prove Useful

A rather complete correlation of existing data and methods of determination should prove useful both as a ready reference and to point the way to new research in this neglected field.

(6) The Glass Phase of Refractories

General

A great deal has been said in recent years concerning the crystalline portion of most varieties of refractories, but as yet the average ceramist has but a hazy picture of the properties of the glass phases of the various refractories.

In this connection, mention is made of Shelton's work[3] on "The Glass Phase in Heated Common Clays." He is also beginning a study of the glass phase in some refractory materials.

Silica-Alumina Refractories

To present this subject, we shall set forth a subdivision with reference to silica-alumina refractories only, but the subject is of equal interest with reference to the other refractories.

Let us consider, under the glass phase of silica-alumina refractories, its nature, amount, properties with varying composition, function in refractories, and melting the reverse of crystallization, as shown by phase diagrams.

(a) Nature of the Glass Phase

What is the physicochemical constitution of the glass phase in silica-alumina refractories on completion of manufacture and in use? What compounds, if any, are present as part of the glass phase, and how are these organized with reference to the remainder of the material in the phase? What is the molecular arrangement in the absence of compounds? In absence of compounds, do certain kinds of molecules form chain or sponge-like structures throughout the remainder of the phase or is the entire phase uniformly heterogeneous?

(b) Amount of Glass Present

What percentage of glass is present in silica-alumina refractories as manufactured, and what percentage at various operating temperatures in use, neglecting fluxes absorbed from the surroundings?

(c) Variation of Properties with Silica-Alumina Ratio

How do rubberiness (extensibility), viscosity, and thermal expansion vary with variation in the silica-alumina ratio? How do these properties vary with variation of the fluxes commonly found in silica-alumina refractories, such as calcium, magnesium, potassium, sodium, and titanium oxides?

(d) Function of the Glass

What are the functions of the glass phase in silica-alumina refractories? To what extent is it the bond, and do the other phases merely float suspended in the glass phase? Does it increase or decrease resistance to thermal shock and how? Does it assist or retard the penetration of fluxes into the refractory and how? What is the relation of the amount of the glass phase of refractories to the thermal conductivity?

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[3] G. R. Shelton, *Jour. Amer. Ceram. Soc.*, **18** [10] 289–96 (1935).

(e) Melting, the Reverse of Crystallization

Following the processes of crystallization on cooling, from phase diagrams, we might believe that, on reheating of refractories in service, the order of melting will be the reverse of that on cooling. If this be so, it should be possible to determine some interesting composition-temperature, viscosity-temperature, and quantity-temperature curves for the glass phase of the various silica-alumina refractories.

(7) The Beneficiation of Refractory Material

There are probably many types of refractory materials that can be economically purified by suitable treatment.

A few possible examples follow:

(*a*) Removal of granular materials such as sand, mica, pyrite, etc., and sometimes the removal of pulverulent iron compounds also, from clays that slake readily in water.

(*b*) Similar purification of "semihard" clays that are difficult to slake.

(*c*) Similar purification of "flint clays." As there is some demand for flint clay in the form of hard consolidated "grog" particles, this section may also involve the secondary problem of reconsolidating the purified flint clay.

(*d*) The matter of the purification of high-alumina materials is always more or less prominent on account of the use of certain relatively pure alumina materials in the manufacture of aluminum metal, in addition to the use of high alumina materials in refractories.

(*e*) The concentration and purification of impure cyanite and of basic refractory materials, such as chrome and magnesite, also present some interesting problems.

Methods of Attack

The methods of attack on many of the above problems may be found in books on ore dressing (such as Taggart's Ore Dressing). It may serve some purpose to enumerate some of the methods.

(1) On crushing, the impurities frequently do not break in the same manner as the material being purified, and crushing to the proper size thus puts the material in suitable condition for purification.

(2) Separating material into size groups may facilitate purification practiced on these sized groups.

(3) Further size reduction after a primary purification may facilitate a secondary purification.

(4) Sometimes an agitating or scrubbing action softens one ingredient without disintegrating some other ingredient.

(5) Actual purifications may be carried on in the dry condition by such methods as screening, air separating, magnetic separating, electrostatic separating, and in other ways, and in the wet state by specific-gravity methods such as "sand wheels," "sand troughs," "wet tables," "overflow tanks," etc. Wet separations may also be effected by differential flotation.

It appears that, if the knowledge of the ore dresser and flotation engineer be combined with what the colloidist, the ceramist, and the soil chemist know concerning deflocculation of clays and soils, some commercially economical separations can be worked out.

(8) The Physics, Chemistry, and Existing Data of Drying Clayware

General

Much has been said concerning apparatus and maintaining proper conditions for drying, but "what are proper drying conditions for any given type of ware?" What actually happens in the ware during drying?

Aspects of Drying Clay

A recitation of some of the aspects of drying clay may serve to illustrate what an interesting subject this is for research.

When clay starts to dry, it shrinks until the moisture is approximately half gone, and during this interval the pores in the clay are supposed to be full of water, and evaporation from the surface during this period is supposedly at substantially the same rate as from a free water surface. Is this so? At the end of the above period shrinkage almost ceases, and the outer ends of pores supposedly become nearly empty, with moisture traveling through them as films on the walls of the capillaries or possibly as vapor in them. Is this a fact? As the piece thus drys from the surface toward the center, do the center pores remain full until finally reached by emptying pores extending in from the surface?

At the stage at which the pores are substantially empty, there is supposedly still some water in the piece, possibly as films on the surface of capillaries. This stage possibly compares with the air-dry condition of clay. From this stage on to substantial equilibrium dryness at 110°C, there is supposedly slight additional shrinkage. If such additional shrinkage exists, is it the same for all clays or does it vary with some measurable fundamental property of the clay, as per problem (3) (see p. 24)?

An efflorescence of soluble salts sometimes appears on the surface of drying clayware. Do such salts arrive at the surface mostly during the full capillary stage of drying or after shrinkage has substantially ceased? Do appreciable amounts of colloidal material travel to the surface with the soluble salts, and do migrating materials stop within the capillaries and tend to retard further drying?

Control of humidity supposedly controls the rate of evaporation from the surface until approximately one-half the moisture is removed (shrinkage has nearly ceased). What function, if any, does control of humidity perform after this stage is passed?

Clays seldom have a porosity of less than 20%, yet slightly damp clay blows up if heated too rapidly in the kiln. Why is this?

The answers to the above mass of more or less conflicting statements should make for industrial economy in the production of clayware.

(9) Firing Fireclay Ware

Cracking of clayware and lump clay during firing entails costs that might largely be avoided if the causes and means of avoidance of such cracks were better known and more generally understood.

Perhaps cracks that appear on firing fire clay and fireclay ware can be divided into (*a*) drying cracks, (*b*) blow-

ups due to wet ware, and (*c*) kiln marking due to wet ware.

(a) Drying Cracks

Supposedly many cracks that are started during drying become boldly apparent only at approximately 925°C, the point at which the γ-alumina content becomes transformed into α-alumina. We shall herein term this the temperature of "primary firing shrinkage." Of course, the gradual secondary shrinkage toward vitrification further accentuates any cracks present. Drying cracks can perhaps be divided into two classes: (1) those which occur because of gross differences in moisture content from one part of the ware to another at some stage of the drying and (2) those which supposedly occur with ware in substantially the air-dry condition.

(b) Exploding Ware

If damp ware be heated too rapidly, it blows up. This is perhaps a strange behavior in the light of the fact that dry clayware always contains appreciable pore space.

(c) Kiln Marking

Does the kiln marking of wet clayware take place while the ware is in the mud stage, or does it occur while the transformation from γ- to α-alumina is taking place?

Drying, Not Firing Cracks

Although the fundamental properties of refractory clays and probably also the surfaces of the individual clay grains show a wide range of variation, and although the primary shrinkage is more or less abrupt and might be expected to cause cracks, it may eventually be proved that cracks formed in firing are not nearly so common as is generally believed. Again, studies of the proportion of water-vapor present in the kiln gases, with reference to cracking, from room temperature through primary firing shrinkage, might prove valuable.

(10) High Alumina Refractories

General

There has been so much misinformation concerning the various types of high alumina refractories that a cataloging of the known facts concerning them should prove helpful to the average ceramist.

Sub-Divisions

Merely for presentation purposes this subject is divided into (*a*) diaspore-containing refractories, (*b*) refractories containing fused alumina, (*c*) refractories containing kyanite and sillimanite, and (*d*) cast mullite refractories.

A classification of the above four types might include: (1) peculiarities of making, including fiirng, (2) properties of product as manufactured, porosity, resistance to spalling, fusion temperature, etc., (3) behavior under heat in use, (4) behavior under heat plus fluxes in use, (5) properties after use, compared with properties as manufactured, and (6) judged by (1) to (5) inclusive, to what services are each of the four above types preëminently suited?

If the above points are thoroughly established, the avenues where research will be most helpful in reducing manufacturing costs and improving products should be more apparent. See also Problem 12 below.

(11) Basic Refractories

General

The unknown fraction concerning this type of refractories is so great that any attempt to outline the vital problems concerning it may not prove very exact. We hope, however, that our effort may prove useful in inciting endeavor.

Under this heading, we may mention (*a*) magnesite, (*b*) chrome, and (*c*) the "baby" refractory, forsterite.

Magnesia and Chrome

As subjects for research or correlation on magnesite refractories, we might mention the following: (*a*) magnesia in silicate systems, (*b*) the relationship between magnesia and the iron oxides, (*c*) magnesia refractories in the open hearth, and (*d*) magnesia refractories in the copper industry.

For discussion of chrome refractories see, under Problem (2), those items which are specific to chrome (p. 23).

In addition to the above subjects, the reader is referred to two previous reports of this Committee.[5]

In conjunction with these last-mentioned reports, we suggest a study of the changes occurring in the various chrome spinels of several type ores when exposed at high temperatures to various oxides of both the RO and R_2O_3 groups. There is evidence of solid solution and changes in the crystal lattice of these spinels which is difficult to study with the petrographic microscope because of opaqueness and the extremely high index of refraction. Such studies, of course, need to be made by means of the X-ray. C. W. Parmelee at the University of Illinois did some X-ray work on this subject several years ago, but limited himself to a study of the spinels[6] only, and not in contact with other oxides.

(12) Optimum Spalling Refractories

General

In considering optimum spalling properties of refractories, we should consider not only their resistance to spalling as manufactured, but also after use in the absence of fluxes and again in the presence of the usual fluxes met in service. These three resistances to spalling frequently differ vastly.

For instance, one type may resist thermal shock excellently as manufactured but have its resistance decrease rapidly in service, while some other type may resist only

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[5] "Elementary High-Temperature Experiments on Magnesite," *Bull. Amer. Ceram. Soc.*, **10** [7] 203 (1931); "Report of Sub-Committee on Magnesite and Chrome," *ibid.*, **9** [5] 164 (1930).

[6] J. H. Chesters and C. W. Parmelee, "Measurement of Reaction Rates at High Temperatures," *Jour. Amer. Ceram. Soc.*, **17** [3] 50–59 (1934); "Reaction-Expansion Measurements on Chromite and Allied Spinels," *ibid.*, **18** [3] 94–100 (1935).

moderately well as manufactured but have such resistance hold up so well that it outlasts the first type.

In types of refractories that do not depend greatly on interlocking crystal structure for resistance to spalling, such resistance possibly depends on rubberiness (extensibility) and thermal expansion of both the grog portion and the bond.

Grogs, or the crystals or groups of crystals serving as grog, can probably be developed to be more rubbery and have less thermal expansion than those used at present. It should be possible to work out combinations of bond plus addition agents such that the bond will have greater rubberiness and lower thermal expansion than at present. In some cases it may be that studies of contact between aggregate and bond can be of use in improving resistance to spalling.

Use

Fireclay refractories having improved resistance to spalling would have many uses. High alumina refractories having improved resistance to spalling should extend the uses of high alumina refractories, and magnesite and silica refractories having improved resistance to spalling would undoubtedly widen the variety of their uses.

(13) Attack of Refractories by Fluxes

For purposes of presentation, this subject is divided into regions (*a*) above slag line, (*b*) at slag (or metal) line, and (*c*) below metal line.

Many factors enter into slagging of refractories. A few are enumerated to point out the opportunities for research.

(1) Solution, by fluxes and running or floating away of the products of reaction.

(2) Penetration of fluxes that (*a*) dissolve material which is then carried to the surface of the refractory where it collects or is carried away, (*b*) remain and alter the structure so that the part affected shrinks, expands, or becomes otherwise unsatisfactory.

(3) Vertical movement of the slag line. The most stable phase above the slag line (metal line) may not be the most stable at the slag line, and the most stable phase below the slag line may differ from the others. In cases of this kind, rapid deterioration is apt to occur within the vertical variation of the slag line.

Penetration studies on various types of refractories of known original porosities and conducted at known temperatures with single oxides, such as soda, iron, and lime, might yield some interesting results.

Does penetration into refractories occur by diffusion through their glass bond, by surface films on the grains, or by passing through the crystal phases? In some cases of penetration it appears possible that certain ingredients of a slag penetrate while other ingredients are apparently held back.

(14) Determination of P.C.E. Values

This problem is the determination of P.C.E. values in different types of furnaces (such as electric, acetylene, gas, natural gas, etc.). It is a problem in which many individuals are greatly interested. A number of brands of brick and clay would be chosen to cover a fairly wide range in P.C.E. values. The procedure of test would be that given in the A.S.T.M. standard methods. This is a problem of much interest to both the refractories producer and consumer. The work should be done in one laboratory and by the same operator. This is not a fundamental problem, but it is an important one.

LOCAL COMMITTEES MAKE PLANS FOR 1936 ANNUAL MEETING

Plans for the 1936 Annual Meeting of the American Ceramic Society which will be held in Columbus, Ohio, March 29 to April 4, began to take definite shape at the meeting of Local Committee Chairmen in the offices of the Society, January 2, 1936. Reading from left to right, those in the photograph are Ross C. Purdy, General Secretary and Chairman, Entertainment Committee; Clyde E. Williams, Chairman, Publicity Committee; Mrs. Ross C. Purdy; Emily C. Van Schoick, Assistant Editor of the Society's publications; Marie E. Eckardt, Assistant Secretary; George A. Bole, Chairman, Local Committee; J. L. Carruthers, Chairman, Plant Trips Committee; John D. Sullivan, Chairman, Meeting Service Committee; and Mrs. Ellsworth P. Ogden, Chairman, Ladies' Entertainment Committee. Other Committee Chairmen are Arthur S. Watts, Exhibits, and C. Forrest Tefft, Finances.

Accompanied by a card sending "all good wishes for your happiness throughout the holiday season," a large carton of holly, mistletoe, and southern smilax was received at the offices of the General Secretary shortly before Christmas. The gift was from Thomas N. McVay, University of Alabama, University, Alabama. The photograph shows part of the office exhibits decorated with this gift from the south.

CZECHOSLOVAK CERAMIC SOCIETY HONORS GENERAL SECRETARY

Ross C. Purdy was elected foreign honorary member of the Czechoslovak Ceramic Society at the eleventh general meeting of this society held at Luhačovice, June 2, 1935.

Announcement was made by R. Pulkrábek, President, and R. Barta, General Secretary, of the Czechoslovak Ceramic Society, in a letter dated November 24, 1935.

"We take the liberty of announcing to you that at the Eleventh General Meeting of the Czechoslovak Ceramic Society, which was held at Luhačovice, June 2, 1935, you were, in acknowledgment of your merits for the ceramic branch, elected foreign honorable member of the same.

"It is with pleasure that we are sending you this report and wish you much success in your further work. At the same time we inform you that the Ceramic School Branch in Modra has dedicated to you, in memory of your nomination, an object[1] which has been made in their workshops, and hope you will kindly accept it. We are sending it together with this nomination.

"We trust we shall be so happy as to have further the honor of your collaboration and that this mutual collaboration will promote the success of the ceramic industry of your country and ours."

[1] See front cover for illustration.

ROSTER CHANGES DURING DECEMBER*

Personal

ATKINS, K. DEAN, Martinsville, Ill. (Moweaqua, Ill.)

CONOVER, RAY C., Harbison-Walker Refractories Co., East Chicago, Ind. (Chicago, Ill.)

DE CELLE, J. A., Chicago Hardware Foundry Co., Elkhart, Ind. (N. Chicago, Ill.)

DODD, ARTHUR E., Lyndale, Crown Street, Port Talbot, Glamorgan, England. (8 Prior St.)

GUASTAVINO, RAFAEL, P.O. Box 3285, Fort Lauderdale, Fla. (New York, N. Y.)

HENRY, EDWARD C., 817 East Beaver Ave., State College, Pa. (New Brunswick, N. J.)

HUTT, GLENN A., Temple Court, Collins St., Melbourne, Victoria, Australia (incorrectly printed "Tensyle Court" in Nov. *Bulletin*).

KIRKPATRICK, F. A., Morton Pottery Co., Morton, Ill. (Unionville, Mich.)

KOENIG, CHARLES J., 151 W. Weber Rd., Columbus, Ohio. (Minocqua, Wis.)

LANDRUM, R. D., 1945 East 97th St., Cleveland, Ohio. (3468 Daleford Rd., Shaker Heights)

LONG, R. N., 1316 Hutchins St., Portsmouth, Ohio. (Newark, Ohio)

LOUDEN, R. H., The Superior Ceramic Corp., Anderson, Ind. (Niagara Falls, N. Y.)

MILLER, WILLIAM J., 7702 Edgewood Ave., Swissvale, Pa. (7337 Schoyer Ave.)

PINCUS, ALEXIS, 97 South Street, Southbridge, Mass. (Hamburg, N. Y.)

SHELTON, G. R., 6614 Delfield St., Chevy Chase, Maryland. (Washington, D. C.)

WEDEMEYER, N. G., Rohm & Haas Company, 222 W. Washington Square, Philadelphia, Pa. (Columbus, Ohio)

ZIMMER, DAVID C., Patterson Refractories Co., East Liverpool, Ohio. (Newcomerstown, Ohio)

* Address in parentheses is old address.

NOTES AND NEWS FOR CERAMISTS

CERAMIC ASSOCIATION OF NEW JERSEY ANNUAL MEETING

The Ceramic Association of New Jersey held its Annual Meeting December 13, 1935, in New Brunswick, N. J.

The following papers were presented at the morning session, held in the Ceramics Building, Rutgers University:

"Factors Influencing the Moisture Expansions of Ceramic Bodies" by L. E. Kane, Dept. of Ceramics, Rutgers Univ.

"The Volatility of Glazes" by Milo A. White, Dept. of Ceramics, Rutgers Univ.

The "Symposium on Substitutes for Ceramic Products" included the following papers which were presented at the afternoon session:

"Tile *versus* Nonceramic Substitutes" by J. R. Kauffman, Dept. of Ceramics, Rutgers Univ.

"Possibilities of Research in the Development of Promotional Programs" by H. R. Cole, Executive Secretary, Tile and Mantel Contractors' Assn. of America, Washington, D. C.

"Ceramics in Architecture" by F. Sturgis Laurence, Port Washington, Long Island.

"Glass *versus* Nonceramic Substitutes" by E. G. Ackerman, Glass Container Assn. of America, New York, N. Y.

The following officers were elected for 1936:

President: V. V. Kelsey, Consolidated Feldspar Corporation, Trenton, N. J.
Vice-President: C. F. Geiger, Carborundum Co., Perth Amboy, N. J.
Councilor: Abel Hansen, Fords Porcelain Works, Perth Amboy, N. J.
Secy.-Treas.: G. H. Brown, Dept. of Ceramics, Rutgers Univ., New Brunswick, N. J.
Asst. Secy.: Ruth Shafer, Dept. of Ceramics, Rutgers Univ.
Executive Committee: J. M. Stangl, Fulper Pottery Co., Flemington, N. J.; H. D. Thropp, Eureka Flint & Spar Co., Trenton, N. J.; G. C. Crossley, United Clay Mines Corp., Trenton, N. J.; H. P. Smith, Joseph Dixon Crucible Co., Jersey City, N. J.; Henry F. Kleinfeldt, Abbé Engineering Co., New York, N. Y.; and H. P. Humphrey, Washington, N. J.

AIR HYGIENE FOUNDATION OF AMERICA, INC.

Air Hygiene Foundation of America, Inc., has been formed by a large group representing various industries, with headquarters at Thackeray Ave. and O'Hara St., Pittsburgh, Pa. This organization is to conduct investigations of and to stimulate research on problems in the field of air hygiene and to gather and disseminate factual information relating thereto. It will also coöperate with and assist other agencies active in this field and will collaborate in the coördination of such research efforts. A comprehensive investigation has been begun at Mellon Institute of Industrial Research, Pittsburgh, under support of Air Hygiene Foundation of America, in which the hygienic, technologic, and economic aspects of air contamination, especially by dust in the industries, will be studied.

H. B. Meller, Managing Director of Air Hygiene Foundation of America, will head this investigation at Mellon Institute. Mr. Meller has been active in research on air pollution since 1920 and is generally regarded as an authority on that subjcet. F. F. Rupert will aid Mr. Meller in this investigational work.

CERAMIC SCHOOL NOTES

Montana School of Mines, Ceramic Division

The occurrence of vast reserves of nonmetallics in the Pacific-Northwest gives rise to a need for engineers trained along ceramic lines, to appreciate and develop this great store of potential wealth.

New Program Started

Recognizing its significant importance as an integral part of an engineering curriculum, the Montana School of Mines is inaugurating a new program in ceramic education. Expansion of present laboratory facilities and equipment, by acquisitions and construction, is being undertaken and at present courses are available covering general ceramics and advanced research on domestic ceramic raw materials. At this time, however, only the degree of Master of Science in Ceramic Engineering is being offered.

Studies Planned

The disastrous effects of recent earthquake shocks in the Helena district of Montana have focused timely interest on the subject of reinforced-brick masonry. The Ceramics Division, under the direction of W. Wurth Kriegel, plans studies along these lines. A clay survey of the State is in progress and a study of the operating clay-products manufacturing plants of Montana was made

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during the past summer. A detailed investigation of the clays of the Kootenai formation, in which the major deposits of the higher grades of commercial clays in Montana occur, is being undertaken by John M. Warde, recently of the University of Alabama, as a problem for graduate research. The extensive chromite deposits of southwestern Montana are being examined as to their possible utilization in the manufacture of refractory materials.

Primitive Pottery Investigated

In coöperation with Melville Sayre, archeologist for the State Bureau of Mines and Geology, work is being done on the ceramic determinations of the first important primitive pottery discovered in the State of Montana by Gerald Kempton who also assisted in the excavation of hundreds of sherds during the past summer.

Ohio State University Department of Ceramic Engineering

Research topics now in progress in the Department of Ceramic Engineering, Ohio State University, are as follows:

(1) Study of Surface Tension of Ceramic Slips.
(2) Production of Underglaze and Overglaze Reds and Pinks.
(3) The BaO–Al_2O_3–SiO_2 System.
(4) The CoO–Al_2O_3–ZrO_2 System.
(5) A Study of Some Low-Temperature Ceramic Frits.
(6) Relation between Composition and Deformation Range of Some Glasses.
(7) Mechanics of Enamel Adherence.
(8) Mechanics of Enamel Suspension.
(9) Electrodialysis of Glass.
(10) Reboiling of Sheet-Steel Ground Coats.
(11) Effect of Aging on Fired Clay Bodies.

—ARTHUR S. WATTS, *Head of Department*

Ohio State University Engineering Experiment Station

The following problems, listed with the names of cooperator and investigator, are now being undertaken at Ohio State University Engineering Experiment Station, Columbus, Ohio:

(1) "A Study of Underglaze Colors" (The Harshaw Chemical Company) W. H. Earhart.

(2) "Fritted Glazes for Tableware" (The United States Potters Association) J. H. Koenig.

(3) "Salt Eutectics" (Edward Orton, Jr., Ceramic Foundation) R. F. Rea.

(4) "Fillers for Brick Roads" (National Paving Brick Association) H. Z. Schofield.

(5) "Bonds for Fire Brick" (Oak Hill Group) W. R. McLain.

(6) "Metal Wear in Ceramic Plants" (Alloy Manufacturers) J. O. Everhart.

(7) "Spitout on Tableware" (Station project) C. J. Koenig.

(8) "Syenite in Ceramic Manufacturing" (Station project) C. J. Koenig.

(9) "Gels as Stabilizers for Cellulated Clay" (Station project) C. E. Curtis.

(10) "Secondary Expansion of Fire Clays" (Station project) J. O. Everhart.—G. A. BOLE, *Research Professor*

Pennsylvania State College

E. L. Hettinger Speaks on Heat-Treatment of Glass

E. L. Hettinger of the Willson Products Company, Reading, Pa., addressed the faculty and students of the Department, November 22. His talk dealt with the history of the heat treatment for the strengthening of glass. After reviewing the technical and patent literature on this subject, Mr. Hettinger performed a number of demonstrations to bring out the characteristic features of the strength possessed by heat-treated glass disks. He also demonstrated a new type of polariscope which uses iodized quinine sulfate, as the polarizing and analyzing material.

F. O. Anderegg Discusses Building Industry

F. O. Anderegg, consultant in the field of building materials, at present located at Mapleton, Pa., addressed the Student Branch Monday, December 16, on "Some Ceramic Problems in the Building Industry." Dr. Anderegg was formerly with the Mellon Institute and the National Bureau of Standards.

D. I. Smith Addresses Group on Potash and Porcelain

Donald I. Smith, a sophomore in ceramics, addressed the Student Branch on the subject of "Potash and Porcelain" on Thursday, December 5. Mr. Smith made a 6000-mile trip through the western states last summer where he saw the new potash developments in New Mexico and the large porcelain plant of the Coors Company at Golden, Colorado.

Walter A. Weldon at the Children's Hour, Baltimore Museum of Art. In keeping with the program of the Art Division of the American Ceramic Society, Mr. Weldon has done much to stimulate public interest in ceramics and appreciation of ceramic art in Baltimore, Md.

COMMUNICATIONS—CERAMIC HISTORY

CERAMIC WARE FIRING

You are requested to contribute a paper and send in names of those qualified to participate in the Symposium on Ceramic Ware Firing, which is to be held on Monday, March 30, 1936, in Columbus, Ohio, during the 38th Annual Meeting of this Society.

What firing and cooling schedule is essential to develop to the maximum the properties that are desired throughout the whole structure of the ware you produce?

How can these properties (virtues) be obtained by economical mass production means?

Are you giving the ware you produce a uniform heat treatment in the kiln, furnace, or oven which you are using?

If not, is it because of too long a while between firings, too much dependence on radiation (toasting), or not uniformly bathing your ware with the heat-transmission medium employed?

Are you cooling your ware uniformly and at that rate which is required to produce the most desirable and most stable physical reactions?

Please consider and make effort to answer these questions, considering your own product and the firing equipment you use.

Please ask questions of yourself and others such as those on pages 398–99, *The Bulletin* for December, 1935. Will you do this?

If we coöperate with one another in disclosing the facts of our ware requirements as affected by firing and cooling, and the advantages and disadvantages of the equipment, methods, and schedules with which we have had experience, there will be developed the most economical ways and means of producing to the maximum, in our several types of ceramic ware, those virtures which are essential to meet competition most successfully.

This is the objective of the Ceramic Ware Firing Symposium at the Annual Meeting, Monday, March 30.

Your coöperation is expected without further prompting.—Ross C. Purdy, *General Program Chairman*

EARTHQUAKES AND MONTANA CLAY MANUFACTURE*

Your letter asked for a brief note stating what the earthquakes at Helena in November, 1935, did to me and to my business. The plant suffered considerable damage. One 40-foot kiln stack was shaken down and three others were badly damaged, but I think by placing 8-inch angle irons on each corner and tying bolts every 6 feet we shall be able to hold them in place. Practically all of the stacked tile were leveled down, and since some of the tile had been piled ten high you can imagine what would happen to a 12- by 12- by 12 three-cell tile being thrown to the ground from a 10-foot height.

The kiln of brick and tile, which were setting at the time of the major quakes on the 18th and again on the 31st, had to be drawn and reset. The brick on the drier cars were shaken off, making it practically impossible to draw a car. The 12- by 12-in. flue lining standing on the dry floor tipped over.

The quake of the 12th was reported of intensity 6, and 5 seconds duration; the one of the 18th, intensity 9, and 30 seconds duration; the one of the 31st, intensity 9, and 15 seconds duration; the one on Thanksgiving Day, intensity 6, and duration 4 to 5 seconds. The instruments at the weather bureau office have reported about 1100 tremors to date.

What it will do to our business: Many of the residences of Helena which were built 25, 30, and 40 years ago were what we used to call a 10-inch hollow wall; two 4-inch walls with a 2- or 3-inch air space, the two walls being tied together with a header now and then. They were all old soft-mud brick, some of them where the two walls and floor joined setting inside four inches. Why they stood at all no one can tell and when they were destroyed they were wholly and completely destroyed. You can understand, of course, what would happen to higher fire walls and any corbelling on buildings.

The new high school, a half-million dollar plant just completed the middle of last September, was a building 526 feet long with a gymnasium wing at one end and a splendid auditorium and science wing at the other end. The gymnasium at the south end today is practically undamaged and the north end has been leveled. In the main, however, buildings which suffered at all and even those which suffered to a great extent, with the exception of the high school building, can be laid to faulty construction, poor designing, very poor material, and poor workmanship.

Six houses completed last year and in various sections of the town are standing today without a crack. The failure of the high school to stand came, first, through failure of the concrete frame and, second, because of its extreme length. So today, we must do what we can for reinforced brick masonry and help in the establishment of proper building codes and more rigid inspection.

—Archie C. Bray

Western Clay Manufacturing Company
Helena, Montana

* From a letter to the General Secretary, received December 8, 1935.

THE PUBLICATIONS OF THE AMERICAN CERAMIC SOCIETY

Conveyers of Valuable Information

By S. I. Perkal

Until July, 1933, the American Ceramic Society published *The Journal, Ceramic Abstracts,* and *The Bulletin,* all under one cover. This joint periodical, published monthly, was, without doubt, of great value to the members of the Society. In every issue the member could find something of special or general interest; either a paper written by himself or by a friend or, in general, a paper interesting to him from a scientific, industrial, and commercial standpoint; or a note on the activities of the Society; or, at least, in *Ceramic Abstracts*—the mirror of world development in ceramics—an abstract of a paper, patent, book, bulletin, etc., of direct or indirect interest to him.

In all, through this periodical, the Society had twelve contacts per year with its members.

But the splendid work carried out by the Society through its publication was considerably improved when the Society began to publish *The Bulletin* in an enlarged format apart from the *Journal* and *Abstracts.*

No doubt *The Bulletin,* in this new form, has become a more effective means of vitalizing the activities of the Society and advancing the coöperative research of technical, scientific, and art questions in ceramics.

Form is a substantial part of content and, like color, is not only a means for decoration but a mighty force in sale and use of ceramic ware. So *The Bulletin* under the new dress not only acquired a more attractive appearance but became a more powerful tool in the Society's effort to serve a useful purpose in the ceramic industry.

Publishing *The Journal* and *Ceramic Abstracts* on the first of the month and *The Bulletin* on the fifteenth of the month, the Society has doubled the number of contacts with its members and in this way multiplied the benefits offered its members.

And now it seems important to make the further logical step forward, *viz.,* to publish *The Journal* apart from *Ceramic Abstracts* and thereby increase the number of contacts to 36.

As in chemistry and ceramics, the finer the grain the greater the surface, the greater the zone of interaction, and the faster the reaction, so in the Society's publishing policy, the finer (smaller) the distances between issues of the Society's "contact means," the greater will be the general contact, the greater the mutual interaction, and the quicker and more effective the benefit offered by the Society to its members.

In addition, *The Journal* and *Abstracts* printed under separate covers will be more convenient to bind and to use.

As an active member of the Society, I suggest the Society's three publications be published separately as follows: First of each month, *The Journal;* tenth of each month, *Ceramic Abstracts;* and twentieth of each month, *The Bulletin.*

In this way there will be established a conveyer of invaluable information to the mutual benefit of the Society and its members, which will strengthen the Society as a body and lead to further growth of the ceramic industry.

P. O. 31, P. O. Box 278
Kharkov, U. S. S. R.

BRICK FOR STREET PAVEMENTS*

Treatise on Brick Pavements Published in 1892

By George F. Schlesinger

Fred L. Manning of the Peebles Paving Brick Company has found in his archives a publication of historical interest, discussing the problem of street paving in general and particularly the brick type as it existed more than 43 years ago. In the brief excerpts from the booklet which will be found below, there are comments and discussions of subjects that are very much alive today. Specifications, methods of tests, and policies that were matters of concern in 1892 are still before us.

The author of this publication, "Brick for Street Pavements," is the late M. D. Burke, who, according to Mr. Manning, served as City Engineer of Cincinnati, Ohio for many years. His purpose in writing it is covered in the last paragraph of the Preface.

If any information or suggestions herein contained shall aid in the construction of better pavements, or prevent the waste of money upon bad ones, or shall bring people to a consideration of placing municipal improvements under systematic control and direction, or shall cause manufacturers to see that their true interest will best be subserved by placing only good material upon the market, then this little pamphlet will have served a useful purpose.

There is a complete description of the tests made on brick submitted, including discussions of how the specimens were prepared and a tabulation of all the results. The following tests were made: (1) chemical analysis, (2) absorption, (3) crushing strength, (4) transverse strength, and (5) resistance to abrasion and impact.

It is interesting to observe that some of these tests, which were discarded when the standard rattler test was adopted, are now being proposed in connection with the test requirements for the modern paving brick. With the exception of the chemical analysis, they will all be used in the current coöperative study of de-aired paving brick.

* Received December 17, 1935

Thirty-eight pages of the booklet are devoted to a description of the tests.

The author makes the following comment regarding crushing strength:

A study of the preceding tables shows that those specimens having a high crushing strength also ranks well in the test for abrasion and impact, and it is reasonable to assume that the power to sustain great weight without crushing would be necessary to the durability of a block placed in a roadway and subjected to the attrition and grinding due to that position. It is true that many experiments or tests are conducted in such a manner and the results given so incoherently that they are of little value, but where the work is carefully done and the record clearly set out, so that knowledge of the comparative strength of different substances can be gained from it, information regarding the crushing strength of any paving material to be used in the form of blocks will be sought and esteemed as of great merit in determining the value of such material.

The unreliability of judging a paving brick by its absorption is observed in the following statement:

Therefore, while it is undoubtedly true that a strictly nonabsorbent material is the best, yet, among paving brick having percentages of absorption lower than three, while the advantage of an exceedingly low rate should not be ignored, other features may be considered. For instance, No. 13 is shown to absorb less moisture than granite, and where it is not to be subjected to an excessive traffic, should on this account be favorably considered, but its endurance under severe tests appears to be exceeded by some of the other varieties.

Of course this publication was written a generation before the rattler for testing paving brick was standardized under the leadership of the late General Edward Orton, Jr. As a matter of fact, the American Society for Testing Materials was not founded until 1898, six years after its publication. The equipment used in making the "rattling test" is described as follows:

The method adopted for determining the relative resistance to abrasion and impact was that which is commonly known as the rattling test. A cylinder about six feet in length by twenty-eight inches in diameter, containing pieces of cast iron, varying in weight from one to six or eight pounds, and in the condition in which it is ordinarily used for cleaning castings, was selected for this purpose. Four brick of each variety (with the exceptions noted in the table) were selected and lettered *G*, *H*, *I*, and *J*, two of the specimens, *G* and *H*, having been soaked for the preceding seventy hours. The specimens were carefully weighed and all placed in the rattler at one time. Billets of wood were put in with them, as is ordinarily done in cleaning castings, to prevent breaking. The cylinder was revolved at a speed of about twenty-four revolutions per minute, and at the end of one thousand revolutions was stopped, the specimens taken out, weighed, and the loss of each noted. The object of making this first test in this particular manner was to wear away the sharp angles or corners and bring each piece as nearly as practicable on a level footing with its fellow for that which was to follow. This first test, therefore, was intended more to equalize the several pieces than to measure their actual wear.

On the following day, the specimens were again placed in the cleaner, omitting the protecting billets of wood, the object now being to observe the survival of the fittest. The cylinder was given three thousand revolutions, occupying something over two hours in time, and although all the pieces were in at the same time, excepting a fragment of No. 15 *I* which had broken off in the former test and was inadvertently omitted, there was ample room for motion and the loss in weight of every piece was a measurable quantity. The individuality of some specimens was lost, as the marks were in some cases almost entirely worn away, but there was no trouble in identifying the varieties; hence, in tabulating the results of this work the percentage of loss in the second rattler test is given for each variety.

In commenting upon this test Mr. Burke says,

Yet it is plain that it presents no condition at all similar to that which obtains in actual service. The brick are loose and battered upon all surfaces, whereas in the pavement they are held firmly in place and subjected to abrasion upon one side only. But in this case they were all subjected to the same treatment, and their losses should give a fair measure of their relative powers of resistance. The "rattler test" has been frequently repeated by various parties, and a practice is coming in vogue of assuming that a half hour or an hour in the rattler is equivalent to a year's wear in the pavement under a given amount of traffic, and from this assumption the probable life of the brick in actual use in the street is calculated.

Many highway engineers are, no doubt, of the opinion that traffic surveys are an innovation of the modern technical age. However, the author devotes over three pages to the subject of "Statistics of Traffic and Durability of Pavements." He refers to observations which were made by employees of the Barber Asphalt Company during the months of October and November, 1885, "in the ten large cities in which that company had offices and works." Mr. Burke, in the following, rightfully contends that traffic data should be officially compiled by municipal officers and not left to private companies who may have an "object in view."

This is believed to be the first carefully prepared census of travel made public in this country, and it was published by an officer of an asphalt paving company. It is fair to presume that one object in view was to show the durability of that kind of pavement under heavy traffic. Since its publication, a few annual reports have contained statistics upon the subject, and the investigation has been greatly extended by the different asphalt paving companies. Obviously, information of this kind should be officially compiled by municipal officers upon a uniform system throughout the country and its scope materially extended.

One of the most interesting sections is that devoted to "Municipal Methods." The same difficult situations, due to politics and interference that make public office difficult to the engineer today, existed then. Incidentally, Mr. Burke delivers a lecture to "those estimable young men annually graduated from our technical schools and colleges," who have been assured by their professors after graduation that they "are now civil engineers." He points out correctly that "continual study and actual practice" will be necessary before they achieve great success in their professional work.

Unless the people at large can be induced to look upon the matter of municipal government as a grotesque absurdity which is really being enacted at their expense, as it is, the code will continue to be enlarged and the Boards multiplied. When they induce the law makers to repeal the thousand and one statutes which now exist, and enact a plain, concise code of rules, and not amend it, which will place the direction of public works under a single department, with uniform regulations in like municipalities throughout the state; placing the designing and

management in the hands of a corps of engineers who should acquire position and promotion by the record of their achievements, and not by reason of race, creed, or previous condition of partisan servitude or influence, and who, being untrammeled as in the world at large, would succeed or fail by merit alone, the principle of natural selection, or the survival of the fittest, would soon place the direction of such works in systematic order under competent control. Then would streets be built to remain undisturbed, as the bottom layers of drains and pipes would first be put down and carried to property lines, then would the character of the pavement be adapted to the uses to which it would be subjected. Paving companies would construct streets and guarantee them to remain in proper form and repair until a specified traffic tonnage should have passed over them. Manufacturers would furnish materials under like conditions. Order and uniform system would exist where chaos now reigns, and legislative interference would cease to trouble executive business.

It must be recalled that this discussion was written a number of years before the motor vehicle was conceived or heard of by anyone in America. In 1896, or four years later, there were only a half-dozen of such vehicles in the country and two of them were on exhibit in circuses. Following are the author's ideas of the requirements for a good pavement.

(1) It must present a secure and pleasant footing for animals.
(2) It must have sufficient smoothness to render traveling in carriages agreeable, and traction easy and as nearly noiseless as is practicable, for all descriptions of wheeled vehicles (excepting those provided with flanged wheels).
(3) It must be of such form and material that liquids falling upon it will quickly flow from it into proper conduits, and must furnish no permanent lodgment for street filth of any kind.
(4) It must be capable of sustaining, without change of form, any and all loads usually transported on public highways.
(5) It must be reasonably durable, both as against the attrition of street traffic, and the destroying or dissolving action of the elements.
(6) It must be economical. That is to say, sufficiently comfortable use must be obtained from it to make it worth both the cost of construction and maintenance.
(7) It must be capable of removal and replacement, or repair from failure at reasonable cost, and with materials and appliance within the control of the street repairing department.

He says that "no pavement yet devised fully meets all of them."

At that time, of course, the single-course concrete slab was not considered for use as a pavement and the author discusses the flexible and the rigid concrete types of foundations. Regarding a *concrete base* and its proper depth, he comments:

The thickness of the concrete varies with the requirements of the traffic, and other conditions, from four to eight or more inches. The ordinary practice is to use natural cement in its composition, and make the coating six inches in thickness for roadways of medium traffic without car tracks. The condition of the subsoil should, however, be considered in determining the depth of concrete, for where it is soft and spongy, or trenches are to be spanned, a greater amount will be required.

After some sixty pages of preliminary discussion, Mr. Burke comes to the matter of definite specifications for brick pavements.

The writer has seen no specifications for brick pavements which either clearly or fairly describe the material to be used, so that the manufacturers or bidders can know just what will be required upon a given work. The majority of the specifications recite that "the brick to be used must be hard, free from defects of any kind, manufactured and burned especially for street paving purposes, be equal in all respects to the sample filed with the proposal, and subject to inspection and acceptance or rejection by the engineer or inspector." With our present knowledge of this material, this phraseology may be accepted, but in reality it specifies very little. Its acceptance or rejection by an engineer is ordinarily regarded by the corporation as a safeguard, but no parties entering into a contract can place a power that is wholly arbitrary and undefined in the hands of an engineer, who is in reality the executive agent of one of the parties.

Uniformity in size and texture appears to be attainable, and lack of it produces many undesirable difficulties. Wide variations in size result from faulty drying and burning. We must either specify how the drying of the brick and the firing of the kiln shall be done, or describe what we want as the product of the kiln and insist upon getting it. In the present state of our knowledge the safer plan will be to name the requirements and leave the manufacturer to wrestle with details.

He finally concludes that it would be best to compare paving brick with granite block, which was No. 1 in the list of samples. In view of the fact that there have been recent tests which indicate that a good de-aired paving brick will compare favorably on an equal basis with granite block, the following paragraphs are of interest:

In any test for determining the resistance to abrasion and impact, the loss of the brick shall not exceed two and one-fourth times that of Lithonia Georgia granite when subjected to like test.

The material shall be subjected to inspection by the engineer placed in charge of the improvement, who will select samples, not exceeding five in number, for each of the tests required for determining absorption, crushing strength, transverse strength, and abrasion and impact, and cause the necessary specimens to be prepared, the tests to be made, and will accept or reject the material in accordance with the results of such trials. An allowance of 20% may be made for variation of single specimens, but the average results shall be in accordance with the provisions herein set forth, or the material must be rejected, and removed at the contractor's expense. The tests may be repeated upon the arrival of different shipments, as frequently as may be necessary to insure the acceptance of only such material as shall comply with the provisions of this specification.

A typical cross-section of the proposed project on Main Avenue is shown, which contains the following details. Width 50 feet, crown $6\frac{1}{2}$ inches, brick 4 inches in depth, sand cushion 2 inches, concrete base 6 inches, 1 inch of gravel on subgrade, stone curb set in concrete 5 by 14 inches, 2-inch tile drains at the edges.

Near the close of his discussion, Mr. Burke reaches certain conclusions as to "where should brick be used for street pavements." His comments, which are quoted below, should have constituted good promotional matter for the paving brick advocate of that day. The practice of making service cuts in pavements which is still being condemned, and probably always will be, is also frowned upon by Mr. Burke.

Upon streets mainly occupied by residences, where

reasonable quiet and correct sanitary conditions are indispensable, brick are in every way superior to stone block pavements, and in durability, when the cost of maintenance is considered, brick are superior to asphalt, because the latter form of pavement, when not used at all, will undergo changes which will render it brittle and practically useless, whereas the brick will not be similarly affected. This change in asphalt from exposure is probably not thoroughly understood, but it is acknowledged to exist and is the principal cause of expense in maintaining pavements made of it. Sheet asphalt is not worn from a pavement by the traffic to such an extent that it would require renewal during the lifetime of a generation, but it is pressed out of position by the traffic, or rendered brittle by changes in its composition.

Brick is, therefore, a suitable material to be used upon a very large percentage of all paved streets, for granite blocks are in no way fitted for use, either upon residence streets or upon such avenues as lead to residence districts, where the driving is at fairly high speed, and should be done with safety and comfort. This brings brick into direct competition with asphalt as a paving material, and, while it must be admitted that the asphalt paving companies are deserving of great credit for their efforts and success in producing good streets, it must also be granted that preserving honest competition will result in public benefit if conducted on correct principles.

Many streets are now opened and paved in a more or less expensive manner, where no such outlay should be made, as the work is totally wrecked in the subsequent laying of gas and water mains, constructing sewers, and making connections with such lines. Common sense would indicate that the order of work should be reversed; that a subgrade should be made; all underground conduits completed and connections therewith carried to property lines; the surface then covered with a coating of gravel or broken stone and gravel, which should be used as a roadway until trenches had become firm, and this metal would then remain on which to place the foundation for the permanent pavement.

This is not saying that brick is the "coming pavement." On the contrary, brick has got here. If used properly, it will stay and will be a standard material for paving streets. In the great cities where traffic is heavily concentrated and little attention is given to the roaring of the passing current, it will never supplant the granite block; in the park drive, the clean rolled surface of hard finely broken stone will not give way to it; the fine avenue, where neatness, order, and style must be maintained, will still be paved with asphalt, but it is to be hoped that the noisome rotting wooden block and the rattling filthy cobble-stone will not remain to annoy every sense of propriety and slowly murder both innocent and guilty by their noxious exhalations.

Upon nine-tenths of the paved streets occupied by residences, retail stores, or office buildings, it would be an error almost criminal to put down the noisy, untidy granite block, and it would be still worse to use the wooden block, as it is ordinarily laid in this country, while a good brick pavement would be quiet, can be kept very clean, and in nearly all such cases would last almost a lifetime, with a minimum expense for repairs.

The advisability of maintenance guarantees is frequently the subject of discussion at meetings of engineering and highway organizations of today. Mr. Burke touches upon this matter as follows:

Contracts for street construction frequently contain provisions requiring the constructor to maintain his work for periods of time varying from one to five or more years, but the meaning usually given this clause by the contractor is that, at the expiration of the time named, he shall make such repairs of the portions of his work which have not been dug up in the interval by some other party as may be designated, and receive the retained percentage. There is uncertainty about this provision remaining in force for any considerable length of time. Enterprising attorneys may argue that assessments should be made for the cost of construction, and that the expense of maintenance should not be assessed, but borne by the corporation, and no one can tell what the court will say until it speaks in deciding the case as then presented. An efficient force, under experienced, skilful direction, employed in the inspection and maintenance of streets would appear to be an absolute necessity in every municipality. If such an organization exists in any American municipality, it has published no report of its services to date. If existing regulations can not be bettered, then our form of government as applied to municipalities is a failure.

Criticisms of the term "vitrified brick" are still current and the author's ideas on this are as follows:

The title "brick," as applied to clay products used for street paving, would appear to the writer as a misnomer. The name ordinarily conveys to the engineer or builder the idea of a brittle porous substance, so hungry for moisture that it must be saturated before being laid in mortar solely for the preservation of the mortar, so brittle that unless combined in masses it has little strength, and in no way suited to withstand the attrition or abrasion of street traffic. When people propose to use such a substance for paving streets, the idea is ridiculed, and they must explain that they are not using building brick, but an entirely different substance, manufactured by brick makers, and, in explaining the matter, use is made of the other unhappy term, "vitrified brick." The only clay product suitable for use in paving streets resembles a tile in more respects than it does a brick, and had the name "tile" been chosen in the place of "brick" a more correct idea would have been conveyed. The first having gone forth, however, it may be expedient to concur in the usual practice, but it will always be necessary to bear in mind that brick as used in street paving is a substance radically different from brick as used in any other connection.

The author advocates the simplification and standardization of paving-brick sizes, which were finally consummated as a result of the first meeting called by former President Hoover when he was Secretary of Commerce in 1921.

A glance at the tables giving dimensions of specimens reveals the curious fact that hardly any two manufacturers make brick of the same size. One of the first steps to be taken by manufacturers should be the adoption of a standard size for street paving brick. Obviously their preference would be to make blocks of about the same dimensions as building brick for both uses. When they make paving blocks only and sell by the square yard, their interest will lie in the direction of increased thickness and diminished width. A large majority of manufacturers supply material for brick masonry as well as for paving, and can assort their output without material loss, thus enabling them to supply better goods for paving when they are required so to do, without suffering the entire loss of the value of such as may be rejected. This from the manufacturers' standpoint, is the greatest argument in favor of making the dimensions of paving brick the same as building brick.

National Paving Brick Association
Washington, D. C.

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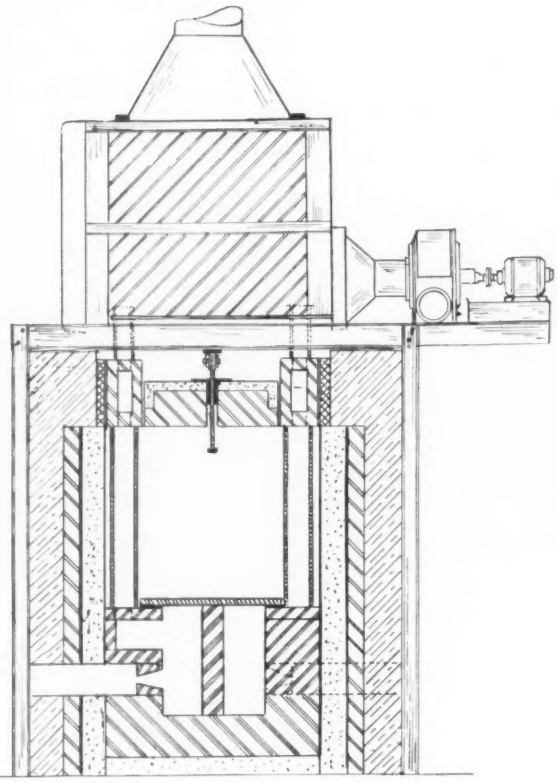

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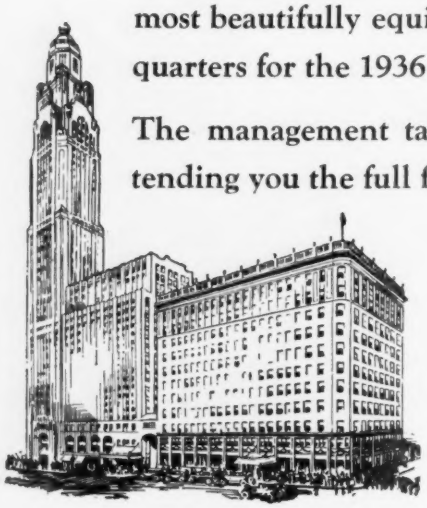

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Simplex Eng. Co.

Automatic Brick Car Loaders
Lancaster Iron Works, Inc.

Ball Mills
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
McDanel Refractory Porcelain Co.
The Vitro Mfg. Co.

Ball Mills (Laboratory Type)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Barium Carbonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Batch Systems
Lancaster Iron Works, Inc.
Simplex Eng. Co.
Simpson Foundry & Eng. Co.

Batts
Carborundum Co. (*"Carbofrax Aloxite"*)
Denver Fire Clay Co.
Norton Co. (*Alundum Crystolon*)

Bitstone
Consolidated Feldspar Corp.
Potters Supply Co.

Blocks (Refractory)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.

Borax
American Potash & Chemical Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Borax Glass
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Boric Acid (Anhydrous)
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Vitro Mfg. Co.

Boric Acid (Crystal, Granular, or Powder)
American Potash & Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Pacific Coast Borax Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Boron Carbide
Norton Co.

Brick Machines (also Barrows, Molds)
Lancaster Iron Works, Inc.

Brick (Refractory)
Carborundum Co. (*"Carbofrax Aloxite"*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.
The Vitro Mfg. Co.

Carbofrax (Refractory Products)
Carborundum Co.
Chicago Vitreous Enamel Product Co.

Carbolon (Refractory Products)
The Exolon Co.

Carbonates (Barium, Lead)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Castings
Lancaster Iron Works, Inc.

Castings (Abrasive Resisting)
Bethlehem Steel Corp.

Castings for Molds and Plungers
Simpson Foundry & Eng. Co.

Caustic Potash
Solvay Sales Corp.

Caustic Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Roessler & Hasslacher Chemical Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Cements
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Norton Co.
Pittsburgh Plate Glass Co.

Ceramic Chemicals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Chromium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay (Ball)
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Potters Supply Co.
The Roessler & Hasslacher Chemical Co.
Spinks Clay Co., H. C.
The Vitro Mfg. Co.

Clay (China)
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay—Cleaners, Feeders
Lancaster Iron Works, Inc.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Kentucky-Tennessee Clay Co.
Spinks Clay Co., H. C.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Ferro Enamel Corp.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky-Tennessee Clay Co.
Metal & Thermit Corp.
Paper Makers Importing Co.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Spinks Clay Co., H. C.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Clay (Fire)
Chicago Vitreous Enamel Product Co
Denver Fire Clay Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Pittsburgh Plate Glass Co.
Potters Supply Co.

Clay (German Vallendar)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co
Ferro Enamel Corp
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Clay Miners
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clay (Potters)
Denver Fire Clay Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
Spinks Clay Co., H. C.

Clay (Process Equipment)
Bonnot Co.
Lancaster Iron Works, Inc.

Clay (Sagger)
Edgar Brothers Co
Edgar Plastic Kaolin Co.
The Hommel Co., O., Inc.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co.
Pittsburgh Plate Glass Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wad)
Kentucky-Tennessee Clay Co.
Potters Supply Co.
Spinks Clay Co., H. C.

Clay (Wall Tile)
Hammill & Gillespie, Inc.
Kentucky-Tennessee Clay Co.
Paper Makers Importing Co
Spinks Clay Co., H. C.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Lancaster Iron Works, Inc.
Simplex Eng. Co.
Simpson Foundry & Eng. Co.

Cornwall Stone (Imported)
Consolidated Feldspar Corp.
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Crucibles (Filter, Melting, Ignition)
Denver Fire Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Simplex Eng. Co.
Simpson Foundry & Eng. Co.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Disintegrators
Lancaster Iron Works, Inc.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Ferro Enamel Corp.
Lancaster Iron Works, Inc.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

Enameling Furnaces
Carborundum Co. (*Carboradiant*)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Lancaster Iron Works, Inc.
Norton Co.
Porcelain Enamel & Mfg. Co.

Enameling Iron (Sheet)
American Rolling Mill Co.

Enameling Muffles
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Norton Co. (*Alundum*)
Pittsburgh Plate Glass Co.

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Pittsburgh Plate Glass Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

Exolon (Refractory Products)
Ferro Enamel Corp.
The Exolon Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Finishing Tools
Simpson Foundry & Eng. Co.

Fire Brick
Carborundum Co.
Denver Fire Clay Co.
Ferro Enamel Corp.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire-Polishing Machines
Simpson Foundry & Eng. Co.

Flint
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Flint Pebbles
Chicago Vitreous Enamel Product Co.
Consolidated Feldspar Corp.
Ferro Enamel Corp.
The Hommel Co., O., Inc.

Floors (Non-Slip)
Norton Co.

French Flint
Consolidated Feldspar Corp.
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Fuel Oil Systems and Control, Stokers
Simplex Eng. Co.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

Glass Bending Ovens, Glass Decorating Machines
Simplex Eng. Co.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.
Simpson Foundry & Eng. Co.

Glass Melting Tanks and Furnaces
Simplex Eng. Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Goggles
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Granulators
Lancaster Iron Works, Inc.

Grinding Mills
Simpson Foundry & Eng. Co.

Grinding Wheels
Norton Co. (*Alundum Crystolon*)

Hearths
Carborundum Co.
(*Carbofrax* heat treating)
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Iron (Enameling)
American Rolling Mill Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Kettles of All Kinds
Simpson Foundry & Eng. Co.

Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.

Kryolith
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Ladles (Cast-iron)
Simpson Foundry & Eng. Co.

Leeds (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Lehrs
Simpson Foundry & Eng. Co.

Lehrs (Electric or Fuel Heated)
Simplex Eng. Co.

Lehr Loaders
Simpson Foundry & Eng. Co.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.

Magnesia (Sintered, Calcined)
Drakenfeld & Co., B. F.
The Exolon Co.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
Norton Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Manganese (Oxide)
The Roessler & Hasslacher Chemical Co.

Masks (Breathing)
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Mixers (Batch)
Lancaster Iron Works, Inc.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace)
Allied Engineering Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Ferro Enamel Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Mullite (Artificial)
The Exolon Co.

Muriatic Acid
Denver Fire Clay Co.
The Hommel Co., O., Inc.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
The Roessler & Hasslacher Chemical Co.
Opacifiers
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Pins
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Potters Supply Co.
Polariscope
Bausch & Lomb Optical Co.
Simpson Foundry & Eng. Co.
Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
The Roessler & Hasslacher Chemical Co.
Solvay Sales Corp.
The Vitro Mfg. Co.
Pot-setting Tools
Simpson Foundry & Eng. Co.
Presses, Side-lever and Bench
Simpson Foundry & Eng. Co.
Producer Glass Plants
Simplex Eng. Co.
Pug Mills
Lancaster Iron Works, Inc.
Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Norton Co.
Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation
Raw Material Handling Equipment
Lancaster Iron Works, Inc.
Simpson Foundry & Eng. Co.
Refractometers
Bausch & Lomb Optical Co.
Refractories
Carborundum Co.
Denver Fire Clay Co.
The Exolon Co.
Norton Co.
Pittsburgh Plate Glass Co.
Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
The Exolon Co.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Titanium Alloy Mfg. Co.
Represses (Automatic)
Lancaster Iron Works, Inc.
Respirators
Willson Products, Inc.
Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.
Salt Cake
American Potash & Chemical Co.
Sand Grinder and Sifters
Lancaster Iron Works, Inc.
Saponin
Jungmann & Co., Inc.
Selenite of Sodium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.
Sheets (Enameling Iron)
American Rolling Mill Co.
Silica (Fused)
The Exolon Co.
The Hommel Co., O., Inc.
Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Philadelphia Quartz Co.
Silicon Carbide
Carborundum Co.
The Exolon Co.
Norton Co.
Silicon Carbide Firesand
Carborundum Co.
The Exolon Co.
Sillimanite (Synthetic)
The Exolon Co.
Pittsburgh Plate Glass Co.
Slabs (Furnace)
Carborundum Co.
Norton Co.
Smelters
Ferro Enamel Corp.
Porcelain Enamel & Mfg. Co.
Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Roessler & Hasslacher Chemical Co.
Solvay Sales Corp.
The Vitro Mfg. Co.
Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.
Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Jungmann & Co., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.
Sodium Silica Fluoride
Jungmann & Co.
Soot Blowers
Simpson Foundry & Eng. Co.
Special Machines
Simpson Foundry & Eng. Co.
Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
Spurs
Potters Supply Co.
Stacks
Lancaster Iron Works, Inc.
Steel Plate Construction
Lancaster Iron Works, Inc.
Stilts
Potters Supply Co
Sulfuric Acid
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Talc
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
Tanks (Pickle)
Chicago Vitreous Enamel Product Co
Ferro Enamel Corp.
Tanks for Raw Material Steel or Concrete
Lancaster Iron Works, Inc.
Simpson Foundry & Eng. Co.
Tile (Floor)
Norton Co.
Tile (Muffle)
Norton Co.
Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Tile (Wall)
Denver Fire Clay Co.
Ferro Enamel Corp.
Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.
Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Trucks
Lancaster Iron Works, Inc.
Tubes (Insulating)
McDanel Refractory Porcelain Co.
Norton Co.
Tubes (Pyrometer)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Norton Co.
Pittsburgh Plate Glass Co.
Valves (Butterfly and Reversing)
Simpson Foundry & Eng. Co.
Water Softening Plants
Simplex Eng. Co.
Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
Winding Drums
Lancaster Iron Works, Inc.
Zinc Oxide
Jungmann & Co., Inc.
Zirconia
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

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American Refractories Institute Type

All that you ask for . . .

This furnace is meeting the demands of your industry for a *portable*, *efficient*, *economical* P.C.E. furnace. In addition, it is dependable and easy to operate.

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*—Requires but 55 cu. ft. of propane gas per run; or but 153 cu. ft. 1000 B.t.u. natural gas.

*—Sturdy, extremely well insulated and lined.

Bulletin 460

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Satisfied customers can come only from a uniform product.

OHCO Frit sales registered a big increase in 1935 over 1934. The reason? . . . a uniform product of the best quality, sold at a reasonable price, and shipped immediately on receipt of order.

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Wet and dry process for cast iron
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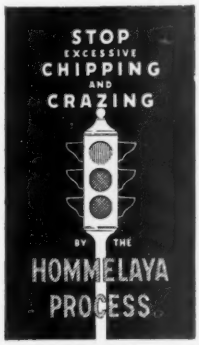

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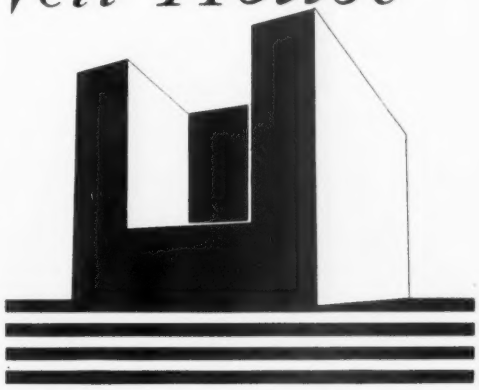
GRANT BUILDING, PITTSBURGH, PA.

The Neil House



Columbus, Ohio

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Reservations are being made now for the 1936 Annual Meeting of the American Ceramic Society.

The Neil House is located in the heart of the city, 655 rooms, all with bath. Rates $2.50 and up single, $3.50 and up double, twins $5.00 and up, suites $7.00 and up. Real hospitality—affording comfort and convenience—three popular restaurants, prompt counter and table service.

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Specializing in
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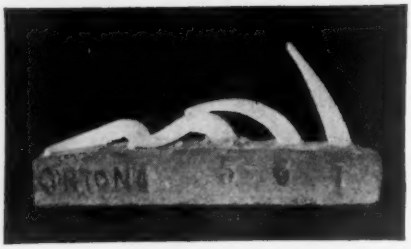

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Nos. 300 and 400 (Patent applied for) have
UNITED STATES BUREAU OF MINES APPROVALS
A Willson style for every dusty operation in the Ceramic Industry.
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1. More than 99.50% Sodium Carbonate (dry basis).
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Make Solvay your source of supply for
DUSTLESS CALCINED 98-100% POTASSIUM CARBONATE
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SPECIFY "CERAMIC" COLORS • CHEMICALS

- FOR ENAMEL—Oxide Colors; Graining, Printing, and Banding Colors
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Aluminum Hydrate
Antimony Oxide
Antimony, Black Needle
Barium Carbonate
Bone Ash
Cadmium Carbonate
Cadmium Sulphide
Cerium Hydrate
Chrome Oxide, Green
Clay, Vallendar
Cobalt Oxide, Black
Cobalt Sulphate
Copper Oxides
Iron Oxides
Kryolith
Lead Chromate
Magnesium Carbonate
Manganese Dioxide
Nickel Oxide, Black
Nickel Oxide, Gray
Nickel Sulphate
Potassium Bichromate
Potassium Nitrate
Powder Blue
Rutile, Powdered
Selenium
Sodium Antimonate
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FOR ASSURED RESULTS . . ●

Our Laboratory is at your service.

CERAMIC COLOR & CHEMICAL MFG.CO.
NEW BRIGHTON PENN'A.

Norton Electric Furnaces Produce Super-Refractories

THREE refractory materials—fused alumina, silicon carbide, fused magnesia (trade-marks "Alundum" and "Crystolon"). Industry employs Norton Refractories in the laboratory and in the plant to handle heat effectively and economically.

Alundum Refractory Laboratory Ware—for ignition, incineration, and filtration. Crystolon Bricks increase the life of boiler furnace linings.

There are Alundum Plates and Shapes for enameling furnaces and ceramic kilns. There are Alundum, Crystolon and fused magnesia cements for all types of furnaces—used wherever high temperatures must be handled.

When handling heat consider Norton Refractories.

NORTON REFRACTORIES

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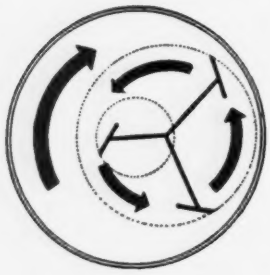
NORTON PRODUCTS—Grinding Machines; Lapping Machines • Grinding Wheels; Abrasives for Polishing; India Oilstones, Pulpstones • Laboratory Ware, Refractories; Porous Plates • Non-slip Tiles and Aggregates



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COUNTER CURRENT
RAPID BATCH MIXERS
Send for Bulletin No. 70-B

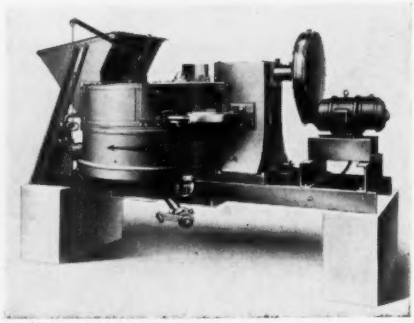
Valuable in the Refractory Industry for uniform dispersement of grains and moisture.

Valuable in the Glass Industry for perfect blending of any batch formula.

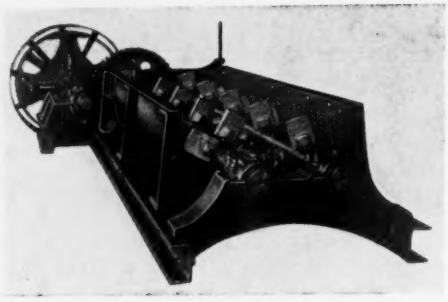
Valuable in the Ceramic Industry for thoroughly mixing components.

Valuable in the Abrasive Industry for coating grains with bakelite or other binders.

Mix . . . quicker and better . . . with a "*Lancaster.*"



The pan rotates slowly clockwise.
The mixing star, off-center, rotates counter-clockwise, rapidly.
The materials must follow a definitely charted course.
Equipped with clever central discharge valve.
Open or closed types for any desired capacity.



"Martin" Double Shaft Granulator.
A modernly designed machine for granulating, mixing and feeding clays uniformly.

"Lancaster"
CLAY
PREPARING
MACHINERY

Clay Cleaners
Granulators
Clay Feeders
Pug Mills
Disintegrators
Crushers

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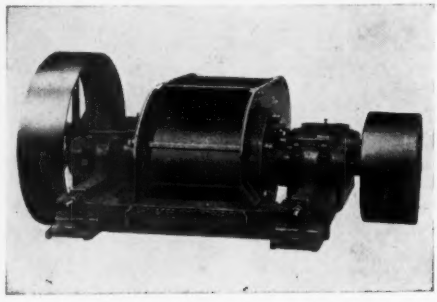
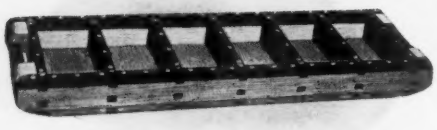


"Martin" Disintegrator.
It has features that have solved disintegrating problems for our leading refractory manufacturers.



***"Lancaster"* Brick Mold.**
Made from selected air dried maple and bound with special carbon steel. Furnished in any desired size or shape for brick manufacture.

"Lancaster"
BARROWS & TRUCKS
Equipped with solid or pneumatic tires and Timken Roller Bearings.
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"Lancaster"
MAPLE BRICK
MOLDS
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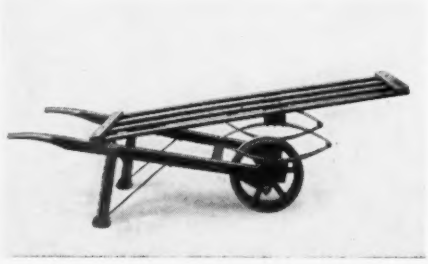
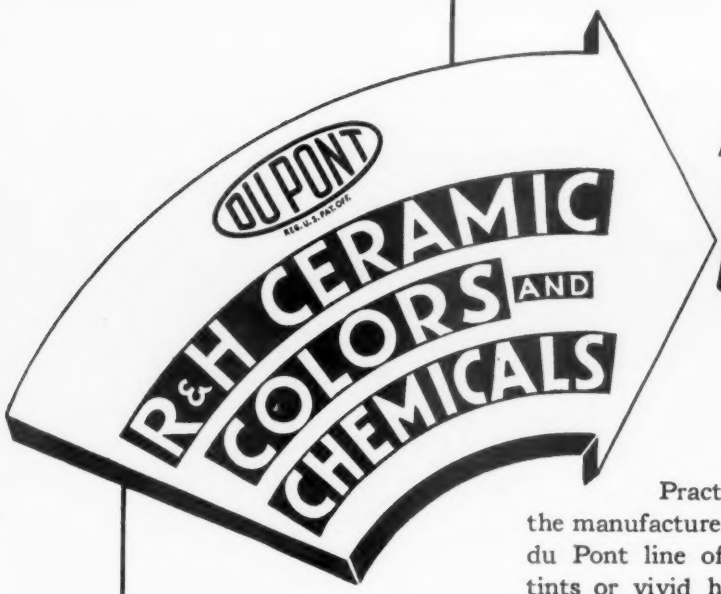


***"Lancaster"* Spring Truck fitted with Rubber Tired Wheel and Timken Bearings.**
We offer a wide selection of barrows and trucks.

It's Time We Got Acquainted

LANCASTER IRON WORKS, Inc., LANCASTER, PENNA.

BRICK MACHINERY AND MIXER DEPARTMENT **JAS. P. MARTIN, MANAGER**



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Precious Metal Decorations - Glass Colors - Body, Slip and Glaze Stains - Color Oxides - Tin Oxide - Raw Materials

Safeguarding Your Service

Skilled maintenance men guard your telephone service day and night. As a result of their vigilance, both local and long distance calls go through more quickly and accurately.

IT'S easy to telephone, but there's nothing easy about giving you good telephone service. It takes many thousands of trained employees to do that.

A considerable part of this work is handled by the Central Office men. Their job is to safeguard service—to prevent trouble from getting a start. They are constantly testing lines, circuits, switchboards and other equipment — working with outside repair men—performing the thousand and one tasks that keep things running right and prevent their going wrong. This work goes on twenty-four hours a day — every day in the year.

The "trouble shooters" of the Bell System work quickly, effectively because of careful training and long experience. Their loyalty, skill and resourcefulness are a priceless tradition of the telephone business.

It is no accident that your telephone goes along for so many months without trouble of any kind. The Bell System gives this country the most efficient, reliable telephone service in the world.

Bell Telephone System

H. C. SPINKS CLAY COMPANY

Miners and Shippers of

BALL, SAGGAR AND WAD CLAY

NEWPORT, KENTUCKY

Jan. 1, 1936

Mr. Pete Potter

Comfortable Sanitary Pottery Mfg. Co.

Pottsville, Ohio

Dear Pete:

First of the year, isn't it? My New Year's wish for you and all the rest of us Potters and Clay Diggers is that we still have plenty of faith in the good old U. S. A. Best country in the world to be born in—live in—and die in. Especially for Ceramists! American Ball and Refractory clays are the best in the world! That's why we call a couple of ours by such modest names as CHAMPION and CHALLENGER. And when it comes to machinery and men, both practical and technical, we have to look back to see the rest of the world.

As one of our old darkeys used to say, "Us got the world in a jug and the stopper in our hand." So let's go, Pete! All we got to do is sell our wares. With plenty of faith in our products and the good old U. S. A., our market, we can do it! We are going to do it, and I predict 1936 will be a happy and prosperous year for all of us.

The best of luck from

The H. C. SPINKS CLAY COMPANY

and Dick Carothers

M&T
Sodium Antimonate

For years M & T Sodium Antimonate has set the standard. The finest opacifier that modern methods can produce, it is always uniform, always pure. Every barrel of M & T Sodium Antimonate is exactly the same, both chemically and physically, as every other barrel.

And, this quality opacifier is more economical. Rejects, due to off colors, become rarities. Whites, whether blue white, cream white or some other hue, do not vary a shade from one year's end to the next where M & T Sodium Antimonate is used.

Our Ceramic Department will gladly help in solving your enameling problems. Homer F. Staley is manager; R. R. Danielson, director of research. Metal & Thermit Corporation, 120 Broadway, New York, N. Y.